A star (✱) indicates that the Abstract deals with Apparatus and Instruments.

JANUARY, 1938.

GENERAL PHYSICS.

ADSORPTION (see Surface Properties).

ATOMIC AND MOLECULAR STRUCTURE.

1. Geometrical Model of the Atomic Nucleus. W. Wefelmeier. *Zeits. f. Physik,* 107. 5–6. *pp.* 332–346, 1937.—Using the α-particle as primary unit, it is shown that the properties of nuclei which are multiples of the α-particle may be correlated with models of the nuclei formed by different types of packing of hard spheres. The models afford explanation of the high stability of nuclei with $Z = N$, of the observed mass defect, and of isotopes. F. C. C.

2. Validity of Methods in Nuclear Calculations. D. T. Warren and H. Margenau. *Phys. Rev.* 52. *pp.* 1027–1031, *Nov.* 15, 1937.—A study is made of several of the methods used to approximate the solutions of nuclear problems, especially the Schrödinger perturbation scheme and the linear variation method. The advantages of individual particle coordinates and relative coordinates are considered, the latter being more accurate. The methods are evaluated chiefly by application to the deuteron, where the possibility of an exact solution permits a check on the rapidity of convergence of the methods employed. The second Schrödinger approximation has been summed for this case, and the convergence is found to be rapid. However, the degree of approximation obtained is poorer than that readily obtainable from the linear variation scheme, using the same functions. This has been verified also for H^3 and He^4. For H^2 the Schrödinger scheme is found to be improved by decreasing the scale parameter (increasing the width) of the exponential functions from 0·60 to 0·45. For the linear variation method, this is not the case, at least if the functions are limited to those of double and quadruple excitation. AUTHORS.

✱3. Mass Spectrography and Nuclear Structure. J. Mattauch. *Naturwiss.* 25. *pp.* 738–747, *Nov.* 12, 1937. *Zeits. f. techn. Physik,* 18. 12. *pp.* 525–534, 1937. *Phys. Zeits.* 38. *pp.* 951–960, *Dec.* 1, 1937.—The evolution of the mass spectrograph is traced from Aston's original velocity focussing instrument to the latest type developed by the author and Herzog [see Abstract 3860 (1934)]. The relative merits of the various instruments are discussed with special reference to the quality of focus, resolving power and intensity of spectra afforded and the general superiority of the Mattauch-Herzog instrument is established. A number of mass-spectrograms obtained by the author are reproduced and discussed in illustration of the general technique of mass spectrography, the discovery of new isotopes, the investigation of rare isotopes and the measurement of exceedingly small mass differences near the limit of resolution of the instrument. In conclusion the rule suggested by the author in 1934, that there are probably no two stable isotopes of neighbouring elements, is discussed. It is indicated that as a result of recent experiments several suspected exceptions have been eliminated and that the three outstanding exceptions may represent isotopes exhibiting instability arising from the theoretically possible inverse β-transformation. It is indicated how experimental mass-spectrographical evidence of the reality of the inverse β-process might be obtained. J. E. K.

*4. **Mass Spectrograph Employing the Parabola Method and Relative Abundance of Argon Isotopes. W. Schütze.** *Wiss. Veröff. a.d. Siemens Werken*, 16. 3. *pp.* 89–98, 1937.—A mass spectrograph of the parabolic trace type is described which is similar to one previously constructed [see Abstract 3148 (1933)] but with general improvements resulting in an increased resolving power of $\Delta m/m = 1/1300$. The canal rays are excited in a metallic discharge tube, traverse a charging chamber which facilitates the study of negative ions, pass through a fine adjustable aperture and are deflected between two magnetic poles used simultaneously as the plates of an electrostatic condenser before impinging on a photographic plate. The relative abundance of A isotopes is measured as $A^{40} : A^{38} : A^{36} = 99\cdot64 : 0\cdot06 \pm 0\cdot005 : 0\cdot31 \pm 0\cdot02$ which is in close agreement with the results of Nier [see Abstract 13 (1937)]. From the appearance of ions of the type H_3^+ as point traces instead of parabolæ it is concluded that these ions are produced by collisions with gas molecules adsorbed on the anode walls. J. E. K.

*5. **Second-Order Focussing Mass Spectrograph and Isotopic Weights by the Doublet Method. F. W. Aston.** *Roy. Soc., Proc.* 163*A*. *pp.* 391–404, *Dec.* 7, 1937.—An improved instrument giving higher resolving power and accuracy is described, together with its use in conjunction with new high-sensitivity photographic plates. Details of the production of doublets due to the isotopes of 17 elements are described, and full data for packing fraction differences, mass differences, and isotopic weights are tabulated. N. M. B.

6. **Formation and Structure of Polymers of the Insoluble Cross-Linked Type. R. G. W. Norrish and E. F. Brookman.** *Roy. Soc., Proc.* 163*A*. *pp.* 205–220, *Nov.* 19, 1937.—A series of cross-linking agents has been described together with the properties of their co-polymers with monovinyl compounds. Support is given to Staudinger's view of the structure of this class of polymer and a general formula is given for such a structure. The view is expressed that the electronic properties of the group X in the divinyl compound $(CH_2 : CH.)_2X$ determines the cross-linking properties in the same way as the electronic properties of R in the monovinyl compound $CH_2 : CH.R$ determines the ease of polymerisation of those compounds. The effect of the presence of the divinyl compound on the rate of polymerisation is also noted. AUTHORS.

7. **Molecular Structures of Boron Compounds. H. A. Lévy and L. O. Brockway.** *Am. Chem. Soc., J.* 59. *pp.* 2085–2092, *Nov.*, 1937.—The electron diffraction investigation of the molecular structures of boron trimethyl, trifluoride, trichloride, and tribromide shows that these molecules are planar with the distances B–C = $1\cdot56 \pm 0\cdot02$ Å, B–F = $1\cdot30 \pm 0\cdot02$ Å, B–Cl = $1\cdot73 \pm 0\cdot02$ Å, and B–Br = $1\cdot87 \pm 0\cdot02$ Å, respectively. These data together with those from six other B compounds support a value of 0·89 Å for the single bond radius of B surrounded by an octet of electrons and of 0·79 Å for B with only six electrons. AUTHORS.

8. **Electron Diffraction Investigation of Seven Chlorobenzenes. L. O. Brockway and K. J. Palmer.** *Am. Chem. Soc., J.* 59. *pp.* 2181–2189, *Nov.*, 1937.—The molecular structures of some of the chlorobenzenes are investigated with the following results :—

Substance	Sum of C–C and C–Cl, Å	C–C (assumed), Å	C–Cl, Å	Cl–Cl (ortho), Å	Cl–Cl (meta), Å	Cl–Cl (para) Å
C_6Cl_6	3·11	1·41	1·70	3·11	5·39	6·22
1,3,5-$C_6H_3Cl_3$	3·10	1·41	1·69		5·38	
m-$C_6H_4Cl_2$	3·09	1·40	1·69		5·35	
p-$C_6H_4Cl_2$	3·09	1·40	1·69			6·18
C_6H_5Cl	3·08	1·39	1·69			
o-$C_6H_4Cl_2$	3·11	1·40	1·71	3·15		
1,2,4,5-$C_6H_2Cl_4$	3·12	1·40	1·72	3·20	5·37	6·25

The decrease of the C–Cl distances below the value 1·76 Å observed in the chloromethanes is due to the contribution of electronic structures which introduce a degree of double bond character in the C–Cl bonds. The resonating structures involved produce distortions in the benzene ring amounting in some cases to an increase of 0·02 Å in the C–C distances. The benzene ring distortion is responsible in part for the increased Cl–Cl separation observed in the unsymmetrical ortho substituted compounds. The distortion of the bond angles in the ortho positions is not as great as has been supposed previously; even with the assumption of a regular benzene ring the ortho bonds are bent to the order of 1°. AUTHORS.

9. Phosphorus at High Temperatures and Pressures. R. B. Jacobs. *J. Chem. Phys.* 5. *pp.* 945–953, *Dec.,* 1937.—A detailed study of the transformations of the element P has been carried out at high hydrostatic pressures and at elevated temperatures. This has resulted in the discovery of a new modification of P, which is noncrystalline in structure and black in colour. Its properties have been investigated to a certain extent. Some new calorimetric data are described which shed light on the question of the relative thermodynamic stabilities of this and the other forms of P. AUTHOR.

10. Molecular Association of Bromobenzene and Other Halogenated Benzene Derivatives. P. Trautteur. *N. Cimento,* 14. *pp.* 265–271, *June,* 1937.—By measuring the refractive index and dielectric constant the electric moment of liquid C_6H_5Br is found. Comparing this with the value for a weak solution of C_6H_5Br in benzene the ratio between the average moment of the molecules in the liquid and that of a single molecule can be found, and assuming the difference to be due to association, degree of association can be determined. This is about 39%. On comparison with other halogenated compounds the degree of association is found to be a fairly regular function of the electric moment. R. P.

11. Mean Free Path of Transformation Particles, Masses of Light Nuclei, and Verification of Absorption Theories. G. Mano. *Soc. Roumaine de Physique, Bull.* 38. 69. *pp.* 51–80, 1937.—The results of 13 reactions in which only elements of atomic weight $\succ$ 16 are concerned, are critically examined and the mean free paths of particles after reaction and the energy evolved as deduced by various methods compared. From these and a similar examination of several other such reactions and results obtained with the mass spectrograph, by application of the method of least squares the masses of these light elements are deduced. The values (X = error × 10^5) are stated to be as follows :—

	Mass	± X		Mass	± X		Mass	± X
^1H	1·00815$_5$	1$_5$	^6Li	6·01689	4	^{11}B	11·01289	6
^2H	2·01476	2	^7Li	7·01821	4	^{12}C	12·00396	8
^3H	3·01701	4	^8Be	8·00795	7	^{13}C	13·00761	7
^3He	3·01712	13	^9Be	9·01506	5	^{14}N	14·00738	8
^4He	4·00395	3	^{10}B	10·01629	6	^{15}N	15·00465	10

Hence the Bethe-Bloch theory is verified, by introducing these revised masses into the energy balance of the transmutations occurring with proton emission ; and by doing the same in respect of reactions involving neutron absorption or emission the mean mass of the neutron is determined as $1 \cdot 000904 \pm 0 \cdot 00006$. C. A. S.

12. Structure of H_3, H_3^+, and of H_3^-. D. Stevenson and J. Hirschfelder. *J. Chem. Phys.* 5. *pp.* 933–940, *Dec.*, 1937.—In this paper, a direct calculation is made of the force constant for bending the nuclei in H_3 and in the ion H_3^+, from a straight line. The neutral molecule has lower energy when the atoms are in a line rather than in neighbouring triangular configurations. The opposite is true for the positive ion. The quantum-mechanical variational method is used together with the most general eigenfunctions which can be compounded from 1*s* H-like orbitals. The polar-homopolar compositions of these eigenfunctions and the effective nuclear charge are varied simultaneously to give the lowest energy. For H_3, the force constant for bending, 15·88 kg.cal./radian², and the corresponding vibration frequency for bending, $3 \cdot 26 \times 10^{13}$ sec^{-1} are obtained. These values agree well with those obtained by the semi-empirical scheme. The force constant for bending H_3^+ from a straight line is − 15·41 kg.cal./radian². This negative value for the force constant indicates that the positive ion has lowest energy for triangular configurations, as predicted by Coulson. The energy of H_3^- is calculated for a linear symmetrical configuration. It is found that for reasonably small separations, H_3^- is unstable with respect to $H_2 + H^-$. At large separations H^- is attracted to H_2 to form a loose cluster but a rough calculation of the equilibrium constant indicates that concentration H_3^-/concentration $H^- = 0 \cdot 2 \times$ pressure H^2 in atm. Thus at the low pressures which are used in the mass spectrograph, H_3^- could not be detected. [See also Abstract **4264** (1937).] AUTHORS.

See also Abstracts 14, 15, 65, 71, 84, 93, 139, 209, 210, 307.

COLLOIDS.

13. Viscosity of Colloidal Solutions of Arsenious Sulphide. A. Boutaric and S. Thévenet. *Comptes Rendus*, 205. *pp.* 862–863, *Nov.* 8, 1937.—The viscosity of solutions of As_2S_3 (prepared by passing H_2S into a strong aqueous solution of As_2O_3) decreases from the moment of preparation and tends to a limit, the more rapidly the higher the temperature. The effect of electrolytes was examined by adding solutions of KCl, $BaCl_2$, $AlCl_3$, and $ThCl_4$ of varying concentration. Minimum viscosity was reached with a lower concentration, but the actual lowering was less, the higher the valency of the added electrolyte. The nature of the anion had no effect, save in the case of basic electrolytes such as KOH or K_3PO_4. C. A. S.

14. Molecular Weight and Viscosity of Highly Polymerised Substances. A. Dobry. *Kolloid Zeits.* 81. *pp.* 190–195. *Nov.*, 1937.—It is found that for certain colloids (nitrocelluloses, polystyrols, etc.) in particular solvents, the courses of the p/c ∼ c curves are not straight lines, so that an extrapolation of the molecular weight for lim c→o is only legitimate for measurements of concentrations below at least 0·1%. The limiting values p/c for lim c→o are identical for a given substance in all solvents; the molecular weight so calculated is the true value which is independent of the solvent. The degree of dispersion of the colloidal particles in all solvents is the same at greater dilution, and the colloidal

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particle is for this reason a macro-molecule in dilute solution and not an associated micelle. The limiting value of the specific viscosity, $R_o = R_{lim. c \to o} = (\eta - \eta_o)/\eta_o C$, deviates ± 8% at the most from the average value. An abnormally high solvation of the colloidal particles, which has been invoked for the explanation of the high viscosities of the highly polymerised substances, does not exist. The viscosimetric determination of the molecular weight, as carried out by Staudinger, is invalid, since different functions of one and the same substance give different viscosities although the molecular weight is the same. The method based on osmotic pressure appears to be the only method free from objection for the determination of the molecular weight of highly polymerised substances. [See following Abstract.] H. H. Ho.

15. Osmotic Method for the Determination of Particle Weights in Colloidal Solutions. Wo. Ostwald. *Kolloid Zeits.* 81. *pp.* 195–199, *Nov.*, 1937.—This paper contains a criticism of Dobry's work [see preceding Abstract] on the molecular weight and viscosity of highly polymerised substances. It is pointed out that contrary to the conception of A. Dobry that the anomalous concentration function of the osmotic pressure of lyophilic sols affords an explanation free from every objection, the general solvation equation of the present author has been both experimentally and theoretically established. A previous determination of the validity of the solvation equation in the region of greater concentrations has also enabled an estimation of the particle weight beyond the experimentally difficult zone of very small concentrations. The recently much employed Limes method for the determination of the particle weights of colloidal solutions by direct osmotic measurements was introduced by the present author in 1929, and developed in collaboration with W. Haller. The challenge of the viscosimetric method of Staudinger for the quantitative determination of absolute molecular weight is agreed to with the citation of further arguments against it. H. H. Ho.

16. Isothermal and Reversible Absorption in Thixotropic Solutions. W. Heller and G. Quimfe. *Comptes Rendus*, 205. *pp.* 857–859, *Nov.* 8, 1937.—The average inter-particle distance in geloids [see Abstract 953 (1936)] should be less than that in the liquefied and homogeneous mixture. As both distances are of the order of the wavelength of visible light the formation of geloids should result in increase of absorption. This is shown to be the case in a thixotropic solution of goethite containing 6·44% of Fe. C. A. S.

17. Recent Work on Gels. H. Freundlich. *J. Phys. Chem.* 41. *pp.* 901–910, *Oct.*, 1937.—Among the subjects reviewed are (*a*) volume changes during the sol-gel transformation, which may be reversible (gelatin, methyl cellulose) or irreversible (silicic acid), (*b*) thixotropy (which is contrasted with Osborne Reynolds' "dilatancy," as of wet sand) and rheopexy, (*c*) swelling. In all cases the influence of solvation (especially hydration) is considered. The relative independence of (*a*), as compared with (*c*), upon pH is ascribed to differences in order between the concentrations concerned. L. V. C.

18. Bonding Force of Cellulosic Materials for Water. A. J. Stamm and L. A. Hansen. *J. Phys. Chem.* 41. *pp.* 1007–1016, *Oct.*, 1937.—To check the possibility of imperfect penetration of cellulosic materials by benzene in density determinations [see Abstract 1342 (1935)], the same samples have now been re-measured with He as a displacing medium. The densities so obtained, which fall between those of benzene and water as displacing medium, are regarded as the true values; by their aid the volume contraction, and hence the increase in internal pressure, in the water phase of a cellulose-adsorbed water system is calculated as a function of water content. From comparison with published specific volume and heat of solution data for aqueous solutions, the conclusion is drawn that the initial bonding force of cellulose for water is about twice that of water for itself. L. V. C.

19. Solution States of the Celluloses. T. Lieser. *Kolloid Zeits.* 81. *pp.* 234–241, *Nov.*, 1937.—After a survey of the different conceptions of various authors with respect to the solution states of cellulose, a more precise viewpoint is now submitted based on new experimental work and on considerations which have been developed by K. H. Meyer and H. Mark. According to this viewpoint, solutions of cellulose in ammoniacal cuprous oxide and copper ethylene diamine possess micellar character like the xanthates, whereas in solutions at low temperatures in organic bases and probably in inorganic acids there exist isolated fibre molecules, which, with rising temperature, re-form the original micelles. The view is expressed that viscosity relationships afford no characteristic expression for the solution states of cellulose. H. H. Ho.

***20. Stress-Strain Characteristics of Wool as Related to its Chemical Constitution. A. M. Sookne and M. Harris.** *Bureau of Standards, J. of Research*, 19. *pp.* 535–550, *Nov.*, 1937.—An apparatus for studying the extensibility of single wool fibres is described. Data on the effects of the tanning (quinone), dyeing, and deamination processes, and of neutral salts on the extensibility of wool fibres are reported. The results indicate that the extensibility of the wool fibres is governed, for the most part, by facts which influence the swelling or hydration of the protein. Salt linkages of the type which might be formed by an attraction between the free amino and carboxyl groups in wool do not appreciably contribute to the physical stability of the fibre in aqueous solutions. AUTHORS.

21. Applicability of the Mie Effect for the Determination of Particle Size in Aerosols. H. Engelhard and H. Friess. *Kolloid Zeits.* 81. *pp.* 129–143, *Nov.*, 1937.—The Mie effect is investigated with regard to its applicability as a method of determining the particle size in aerosols. Curves of scattering as a function of direction are determined for a number of coarsely dispersed aerosols not possessing specific absorption. The particle sizes are also determined in the ultramicroscope and by sedimentation analysis. The theoretical curves for particles with diameters up to $1 \cdot 5\mu$ are calculated from the Mie formula for a substance with refractive index $1 \cdot 44$. The applicability of the effect for the determination of particle size in colloid systems is discussed and it is concluded that reliable results can be obtained for sizes between about $50\mu\mu$ and 500 to $600\mu\mu$. Below the lower limit the Mie effect does not occur; above the upper limit the nature of the scattering curves becomes too uncertain. L. A. W.

22. Recent Work on Aerosols (Dust, Smoke, Fog). W. L. H. Moll. *Kolloid Zeits.* 81. *pp.* 225–234, *Nov.*, 1937.—The author gives a very complete survey of work dealing with aerosols during 1934–36, and first collects together the most important scientific results under the following sections: General properties of aerosols; preparation methods, analysis (particle-number, -concentration, -magnitude, electrical and optical properties); coagulation (in the gravitational, electrical, acoustical and thermal fields); absorption of fogs in liquids; meteorology; dust in industry (survey of various industries, flue gases, dust explosions, gas purification); fog removing agents; filters. A very complete Bibliography of 220 references contains publications on aerosols exclusive of dissertations, patents, and popular articles, and is arranged alphabetically according to the authors' names. H. H. Ho.

23. Spontaneous Emulsification and Reactions Overshooting Equilibrium. J. W. McBain and Ts-Ming Woo. *Roy. Soc., Proc.* 163*A*. *pp.* 182–188, *Nov.* 19, 1937.—The phenomenon of spontaneous emulsification in the absence of all external mechanical stirring, known to classical physics, was observed and studied. It is partly due to local movements resulting from lowered surface tension, but an important factor is the collision of molecules in diffusing columns driving other molecules with them. AUTHORS.

24. H.F. A.C. Electroosmosis between Plane Parallel Walls. L. Rosenhead and J. C. P. Miller, *with note by* **J. J. Bikerman.** *Roy. Soc., Proc.* 163*A*. *pp.* 298–317, *Nov.* 19, 1937.—Mathematical. The dispersion of electroosmosis does not occur even at frequencies as high as $10^5 \sim$. Hence the theory of surface conductivity cannot be checked by measuring its dispersion. The discrepancy between values of surface conductivity found by various workers cannot be due to differences in the frequencies of a.c. used. A. J. M.

***25. Quantity Heads for Air-Driven Ultracentrifuge. R. W. G. Wyckoff and J. B. Lagsdin.** *Rev. Sci. Instruments*, 8. *pp.* 427–429, *Nov.*, 1937.—Quantity heads for the air-driven ultracentrifuge are being employed to centrifuge 100–150 cm^3. of liquid in fields up to 200,000 to 300,000*g*. The design of such rotors is described and experimental results are given that indicate their limiting strengths and their performance with the driving mechanism now used. [See Abstract 2337 (1937).] AUTHORS.

26. Disperse Gases. Part III. W. Luchsinger. *Kolloid Zeits.* 81. *pp.* 180–182, *Nov.*, 1937.—The variation with their size of the time taken by bubbles of air to rise in water has been determined. The curve between volume of bubble and time of rising shows a rapid decrease in the time up to 0·004 cm^3. For bubbles larger than this there is a slight increase in the time, but above a limiting size the velocity of rising is constant. [For Part II see Abstract 4282 (1937).] A. J. M.

27. Effect of Ultrasonic Waves on Solubility of Colloids. Part III. N. Sata. *Kolloid Zeits.* 81. *pp.* 182–187, *Nov.*, 1937.—The peptisation of charcoal by ultrasonic waves is more complete in diethyl ether than in other organic liquids used. The moisture present in the charcoal acts as a peptising agent. After heating to 100°, dry carbon shows no peptisation. Moisture only acts in this way when ultrasonic waves are used as the dispersing agent. The limiting amount of moisture necessary for peptisation to occur was determined. It is approximately equal to the solubility of water in the ether used. [For Part II see Abstract 2319 (1937).] A. J. M.

See also Abstracts 30, 90, 312, 317.

CRYSTAL STRUCTURE AND SPECIAL PROPERTIES.

28. Derivation of the Number of Axes of Symmetry. H. Tertsch. *Zeits. f. Krist.* 98. 3. *pp.* 275–278, 1937.—Following the definition of an axis of symmetry, it is shown that each *n*-fold symmetry axis is a possible crystallographic edge direction; that each symmetry axis is simultaneously a surface normal to a crystal surface perpendicular to it. It is further shown that 6-, 4-, 3-, 2- and 1-fold axes only are possible. C. J. B. C.

29. Laue Diagrams. F. Laves. *Naturwiss.* 25. *pp.* 705–708, *Oct.* 29, *and pp.* 721–733, *Nov.* 5, 1937.—A twenty-fifth anniversary review of the theory and applications of the Laue method of X-ray analysis of crystal structure. Particular reference is made to the determination of ionic and atomic radii in crystals, and their variation according to the type of binding (ionic, homopolar, van der Waals and metallic). A. J. M.

30. Debye-Scherrer Patterns of Germanium between 20° and 1110° Abs. H. Nitka. *Phys. Zeits.* 38. *pp.* 896–901, *Nov.* 15, 1937. *From the Reichsanstalt.*—It is shown by means of X-rays that no allotropic transformation of Ge occurs within the range 20°–1110° Abs. and the author discusses the bearing of the results upon the anomalous temperature-change in the electrical conductivity and specific heat which has been found to occur with Ge. A. G. Q.

31. Structure of Zinc Meta-Antimonate. G. L. Clark and D. A. Reynolds. *Zeits. f. Krist.* 98. 3. *pp.* 185–190, 1937. *In English.*—Zinc meta-antimonate, $Zn(SbO_3)_2$, is shown to crystallise in the tetragonal system with a body-centred unit cell containing 2 molecules; $a_0 = 6 \cdot 585 \pm 0 \cdot 005$ Å; $c/a = 0 \cdot 783$. The theoretical density is 6·1, compared with 6·5 for the experimental value. The atoms appear to be arranged according to the demands of the space group D_{2d}^8-$P\bar{4}n2$, distributed as follows: 2 Zn: (*a*) 000, $\frac{1}{2}\frac{1}{2}\frac{1}{2}$; 4 Sb: (*f*) X, $\frac{1}{2}$-X, $\frac{1}{4}$; X, $\frac{1}{2}$ + X, $\frac{1}{4}$; $\frac{1}{2}$ + X, X, $\frac{3}{4}$; $\frac{1}{2}$-X, X, $\frac{3}{4}$; X = 0,34; 12 O: positions undetermined; SbO_3^- group evidently planar. AUTHORS.

32. Structure of Animal Tissues. F. O. Schmitt. *Naturwiss.* 25. *pp.* 709–715, *Oct.* 29, 1937.—Methods of investigation of tissues are described, the tissues, if necessary, being kept moist in special chambers which are also described. It has been shown that tendons are composed of crystals of very high molecular weight. Muscle structure varies as to whether it is fresh or dried. The phenomena of contraction of tissues were first investigated by this method in hair by Astbury, who showed that keratin molecules were oriented in layers and the elasticity was due to long molecular chains. Muscle tissue has the structure of α-keratin and contraction is due to the longitudinal arrangement of molecules, these results being in agreement with microscopic and polarisation investigations. The interference method allows investigation of the lipoids of nerve tissue. Diagrams show the presence of two periods of 4·8 Å and 17 Å, the smaller period being due to the lipoids, present in a state of mixed liquid crystals. This constitution is discussed in respect to the excitation and conduction of the tissue. The assumption of the presence of electrical membranes and special dielectric properties, as made in electro-physiological investigations, is of interest as X-ray investigations shows the existence of a myeline layer in fresh vertebral nerve tissue. Whilst treatment with alcohol reduces the diameter of the nerve tissue to half, there is scarcely any change of ultra-structure. The major portion of tissue of a nerve axon is present in unorientated form. Tissue orientation is discussed in respect to variations between embryonic and developed tissues. B. J. L.

33. Presence of Crystallisation Nuclei Above the Melting Point and the Structure of Liquids. V. Danilow and W. Neumark. *Phys. Zeits. d. Sowjetunion,* 12. 3. *pp.* 313–323, 1937. *In German.*—The dependence of supercooling on previous heating has been investigated for water, Bi, Hg and Sn, and the temperature range for each substance has been determined where such dependence exists. It is concluded that substances whose structures in the solid state differ widely from the structure of the ideal liquid, exhibit a sharper and decided inclination towards supercooling than compounds which exhibit dense packing in both the liquid and solid states. The paper is replete with experimental detail, and previous hypotheses are thoroughly discussed. H. H. Ho.

34. Nucleus Formation on Recrystallisation. Part VI. M. Kornfeld and W. Pawlow. *Phys. Zeits. d. Sowjetunion*, 12. 3. *pp*. 301–306, 1937. *In German.*—The relation between the rate of formation of nuclei and of the rate of growth of new grains and temperature is investigated for the case of Al crystals. Over a wide temperature range and for a 4% deformation the rate of growth (v) is given in terms of the temperature (T) by the expression $v \sim 4\cdot5 \times 10^7 e^{-1700/T}$. No simple relation is found between the rate of formation and temperature. [For Part V see Abstract 2917 (1937).] H. J. H. S.

*35. **Preparation of Large Single Crystals of Sodium Chloride. H. Walther.** *Rev. Sci. Instruments*, 8. *pp*. 406–408, *Nov*., 1937.—An apparatus and a method are described, whereby single crystals of NaCl are produced in the form of bars 2 cm. in dia. and 30 cm. long. The crystal is drawn from the melt by means of a Pt rod which is dipped into it and then raised and rotated simultaneously by a clock mechanism. An air stream from a circular nozzle surrounding the growing crystal immediately above the surface of the molten salts provides the steep temperature gradient necessary for the continuous growth of the crystal. The orientation of the crystal with respect to the axis of the bar may be chosen at will. AUTHOR.

36. Zircon of Lower Density. J. Lietz. *Zeits. f. Krist.* 98. 3. *pp*. 201–210, 1937.—The so-called modifications of zircon have been examined in a Debye-Scherrer camera with filtered CuK-radiation, using the crystals employed by Gause (Dissertation, Hamburg, 1936) in his work on the optical and thermo-optical properties. Normal zircon has a density 4·7. Zircon of medium density (for which a new symbol should be used, *e.g.*, meta-zircon), consists of the normal zircon lattice together with amorphous substance, which is probably rendered isotropic by α-rays. By heating to glowing the zircon lattice is reformed. The zircons of lowest density are almost completely isotropic. By glowing ZrO_2, SiO_2 is rebuilt and besides a zircon lattice with larger spacings. The name zirconoid has been proposed for this crystal. From powder photographs the lattice constant of cubic ZrO_2 in zircon is 5·16 ± 0·01 Å, and the size of the ZrO_2 blocks estimated. A small expansion in the zircon lattice produced by the glowing process is established. C. J. B. C.

37. Structural Formulae and Classification of the Clays. J. de Lapparent. *Zeits. f. Krist.* 98. 3. *pp*. 233–258, 1937. *In French.*—The existing knowledge of the structure and properties, and the connections between these, of the various clays are discussed in detail. As a result they are classified according to the thickness of the ultimate leaflets. Clays with 7 Å leaflets include kaolinites (with serpentine in which 3Mg replaces 2Al as the magnesian analogue), anauxites, beidellite and halloysite; with 10 Å leaflets, pyrophyllite, to which the magnesian analogue is talc, attapulgites including the palygorskites and their magnesian analogues the sepiolites, the attapulgites proper, and bravaisites, which verge into glauconites as the Fe content increases; lastly the clays with 14Å leaflets, montmorillonite, and with Fe replacing Al, the nontronites. C. A. S.

38. Quantum Efficiency of Colour Centre Building in KCl and NaCl. G. Schaltberger. *Göttingen Nachrichten, Fachgruppe II.* 2. 15. *pp.* 181–186, 1937.—Measurements have been made on the efficiency of photochemical conversion of U centres into F centres at various temperatures between 20° and 220° C. The efficiency rises with temperature in much the same way as found by Hilsch and Pohl for KBr crystals but the actual values of the efficiency are smaller. J. E.

39. Crystal Adjustment for Oscillation X-Ray Photographs. O. P. Hendershot. *Rev. Sci. Instruments,* 8. *pp.* 436–438, *Nov.,* 1937.—The method somewhat resembles that of Kratby and Krebs, but should introduce less uncertainty into the calculations for the final adjustment of the crystal. [See Abstract 5384 (1936).] C. A. S.

See also Abstracts 47, 81, 82, 164, 236, 246, 249, 380, 381.

DENSITY.

See Abstracts 36, 193.

DIFFUSION AND OSMOSIS.

40. Diffusion of Lithium Ions Through Quartz in an Electric Field. P. M. Harris and C. E. Waring. *J. Phys. Chem.* 41. *pp.* 1077–1085, *Nov.,* 1937.—Comparative sizes of crystal "pores" and ionic diameters, and known experimental results suggest that thin crystals of quartz might serve as simple Graham's law diffusion membranes for use in concentrating $_3\mathrm{Li}^6$, and an investigation is described of the mechanism of the transport of Li^+ through quartz, using special cells, by electrolysis under various conditions of voltage and temperature. Results are plotted and analysed mathematically. A satisfactory value of the dielectric constant to be attributed to an ion immersed in one of the pores of the quartz is deduced. N. M. B.

41. Attempt to Detect the Passage of Helium through a Crystal Lattice at High Temperatures. (Lord) Rayleigh. *Roy. Soc., Proc.* 163*A*. *pp.* 376–380, *Dec.* 7, 1937.—It is known that He will pass through silica glass, even at ordinary temperatures. A plate 1 mm. thick and 1 sq. cm. area will pass about $2 \cdot 5 \times 10^{-1}$ mm^3./day. In this case the He probably passes through submicroscopic channels or cracks in the material. No single crystal, so far as has been ascertained, will pass measurable quantities of He through the lattice at ordinary temperatures. Mica has now been tested up to a temperature of 415° C. The amount of He passed, by a plate 1 mm. thick and 1 sq. cm. area, if any, is certainly less than 7×10^{-5} mm^3./day. AUTHOR.

42. Experimental Development of Thermal Diffusion. T. L. Ibbs. *Physica,* 4. *pp.* 1133–1140, *Nov.,* 1937. *In English.*—The general nature of the problem is first discussed including consideration of Chapman's studies of the theoretical aspects of the physical consequences of the thermal diffusion effect. Experimental work is then described, mixtures of five pairs of gases being examined in numerous mixtures of widely varying proportions. The results showed that thermal diffusion was of general occurrence in gas mixtures, and that the molecules could be regarded as obeying an inverse law of repulsion; the least separation was obtained in mixtures of N_2 and CO_2 and the greatest in mixtures of He and A. It is noteworthy that the separation for the latter is greater than for H_2–A, a result pointing to the extreme hardness of the He molecule. Work at low temperatures is next discussed, from which it appeared that the hardest molecules are those with the low liquefying-points, while CO_2 exhibited peculiar behaviour. Finally the recent experiments of Blüh, of Grew and Atkins and of Harrison are briefly discussed, from the latter of which was deduced that the Rn molecule must be very soft. As thermal diffusion tends to occur in all cases where there is a temperature difference in a mixture of gases, its practical temperature cannot be neglected. H. H. Ho.

43. Thermal Diffusion in Gas Mixtures. G. Blüh, O. Blüh and M. Puschner. *Phil. Mag.* 24. *pp.* 1103–1114, *Dec.*, 1937.—By means of an interferometer method, which is described, thermal diffusion in gas mixtures (H_2–CO_2, H_2–N_2, He–A, He–Ne) was observed, and the effect found generally to agree with Ibbs's experiments. From the measured total separations the values of the indices of repulsive forces of the molecules were calculated according to Chapman's theory, and found to be in good agreement with the values obtained by other methods. AUTHORS.

See also Abstracts 80, 308.

ELASTICITY AND PLASTICITY.

44. Maximum Error in the Application of Saint-Venant's Principle in an Isotropic Solid. O. Zanaboni. *Accad. Lincei, Atti,* 25. *pp.* 595–601, *June* 4, 1937.—In accordance with the principle of Saint-Venant, the author has shown [see Abstract 3375 (1937)] that, for elastic bodies subjected to given superficial forces, the work of deformation continually diminishes to a limit as the dimensions of the body increases in an arbitrary but determined way. He now establishes certain theorems on the maximum difference between the work of deformation and its limit, and applies his results to the cases of isotropic bodies in two and three dimensions. In two dimensions the maximum error is inversely proportional to the square of the distance, in three dimensions to the cube of the distance. A. J. McC.

45. Torsion of Conical Shells. R. V. Southwell. *Roy. Soc., Proc.* 163*A*. *pp.* 337–355, *Dec.* 7, 1937.—The author shows how the idea that a shell in torsion may be considered as formed by the bending of a thin plate in shear, which he has used in discussing the torsion of thin cylinders, may be also applied to the torsion of thin conical shells. In the case of a non-circular cylindrical shell, twist is accompanied by a warping of the sections, there being a displacement along the generators. In the case of the conical shell, such a displacement would involve an extensional strain, and considerations of energy show that it cannot occur. The necessary displacement in this case, which must exist to relieve the stress, must therefore be perpendicular to the generators. This is examined in detail, and a complete set of formulæ is given. W. G. B.

46. Elasticity of Amorphous Bodies. P. Kobeko, E. Kuvshinskij and G. Gurevich. *Techn. Phys., U.S.S.R.* 4. 8. *pp.* 622–637, 1937. *In English.*—A notion is introduced of two components of reversible deformation: initial elastic or acoustic deformation and highly elastic deformation. Total mechanical deformation of amorphous bodies is composed of three independent components: the elastic initial deformation, resilient highly-elastic deformation and inelastic plastic deformation. The initial modulus of shearing stresses in amorphous bodies is large. For phenol-phthalein, hard rubber and soft rubber it is equal to 2×10^4 kg./cm^2. and to 10^4 kg./cm^2. for rosin. The total modulus is many times less than the initial one. For soft rubber it is equal to 6 kg./cm^2., for hard rubber—30 kg./cm^2., for phenol-phthalein—2500 kg./cm^2. The setting-in time of highly elastic deformation drops very sharply with increasing temperature. Soft rubber and hard rubber are highly elastic at high temperatures as well as at low temperatures. Cooling produces only a drop in the velocity of setting-in of the highly-elastic deformation, but the limiting magnitude of deformation does not change. The hardening of soft rubber and hard rubber takes place not by jumps, but gradually as the temperature goes down, and is similar to the process of turning into glass of monomeric bodies. The manifestation of highly elastic properties may take place at greatly differing viscosities. In polymers the viscosity in the softening interval is very large compared with that of monomeric materials. AUTHORS.

47. Elastic Constants of Anisotropic Solids. H. A. Jahn. *Zeits. f. Krist.* 98. 3. *pp.* 191–200, 1937. *In English.*—A general group-theoretical method by which the relations between the elastic constants of a symmetrical solid can be determined very easily is given and used to extend the results obtained by Voigt for the crystallographic groups to every possible group of symmetry. AUTHOR.

See also Abstract 195.

GRAVITATION.

48. Second-Order Disturbance Terms in Pendulum Observations at Sea. F. A. V. Meinesz. *K. Akad. Amsterdam, Proc.* 40. 8. *pp.* 650–653, 1937.—These disturbance terms are due to ship's motion and even in submerged submarines may exceed 10 milligals. The second-order disturbance term takes the form $\delta g = -\overline{\ddot{x}^2}/4g + \overline{\ddot{y}^2}/2g + \overline{\ddot{z}^2}/2g$ but it is true only for accelerations of periods long compared with the periods of the pendulum and of the damped pendulums of the pendulum apparatus. When the periods are short in comparison the effect is negligible. Methods of determining the acceleration and the means of correcting earlier results given by the Netherlands Geodetic Commission are discussed. Further tests are to be made at sea. R. S. R.

See also Abstract 69.

HYDRODYNAMICS AND AERODYNAMICS.

49. Extensions of the New Family of Wing Profiles. R. W. Piper. *Phil. Mag.* 24. *pp.* 1114–1126, *Dec.*, 1937.—In this paper the use of the transformations [see Abstract 4337 (1937)] has been extended, (*a*) to reflex the tail of the aerofoil and so restrict or eliminate the travel of its centre of pressure; (*b*) to produce a section with an arbitrarily sharpened nose. The extensions developed separately, for simplicity, are not mutually exclusive, and may be combined, if desired, to give a cambered profile with a stationary centre of pressure and an arbitrarily sharpened nose. AUTHOR.

50. Production and Dissipation of Vorticity in a Turbulent Fluid. G. I. Taylor. *Roy. Soc., Proc.* 164*A*. *pp.* 15–23, *Jan.* 7, 1938.—When isotropic turbulence is set up in a fluid, *e.g.*, by moving a grid of regularly spaced bars through it, the average vorticity decreases with time.

This decrease is due to viscosity. Recently v. Kármán has calculated the rate at which vorticity is destroyed by viscosity. His equation involves only quantities which can be measured in a wind tunnel by means of the hot wire technique. These quantities are now measured in one case, and the rate of decrease in the mean square of the vorticity is also measured. In this case it is proved that the rate of destruction of vorticity by viscosity is four times as great as the rate at which vorticity disappears. Vorticity therefore is necessarily being produced by extension of vortex filaments three times as fast as it is disappearing. It seems that the stretching of vortex filaments must be regarded as the chief mechanical cause of the high rate of dissipation associated with turbulent motion. AUTHOR.

51. Plane Motion of Incompressible Fluid. I. Imai. *Phys. Math. Soc., Japan, Proc.* **19.** *pp.* **922–936,** *Oct.,* **1937.** *In English.*—Solutions of the equations of steady two-dimensional motion of an incompressible fluid are sought in which the stream-lines are similar curves with the centre of similitude at the origin, the stream-function being a function of $r\, f\,(\theta)$ only, where r and θ are polar coordinates and f is a function to be found. For an inviscid fluid all possible solutions are found, both in the absence and in the presence of vorticity. Several solutions are also found for a viscous fluid: the author is of opinion that no other solutions exist, but is unable to prove this statement. The solutions include the logarithmic-spiral flow discussed by Hamel: the physical significance of the solutions is not otherwise discussed. S. G.

52. Dynamics of Compressible Fluids at Supersonic Velocities. C. Ferrari. *Pont. Acad. Sci., Acta,* **1. 4.** *pp.* **29–35, 1937.**—The author discusses, hydrodynamically, certain problems concerning the motion of compressible fluids at velocities greater than that of audible sounds. Recent work is critically summarised and emphasis is laid on the important applicability of the present studies to problems of aerodynamics, propagation of explosive waves, ballistics, and the theory of internal combustion engines. Treatment is essentially mathematical. J. E. B.

53. Constant Velocity of a Falling Sphere. N. Frössling. *Gerlands Beitr. z. Geophys.* 51. 2–3. *pp.* 167–173, 1937. *English Abstract.*—A graphical method for calculating the stationary velocity of a falling sphere is described. The approximate formula for the velocities in the whole subcritical range is: $1/v = (9\,\eta/2\,\rho_1\,g)\cdot(1/r^2) + \sqrt{(0{\cdot}169\,\rho/\,\rho_1\,g)}\,(1/\sqrt{r})$, ($v$ = stationary velocity; η = coefficient of viscosity; ρ = density of the fluid; ρ_1 = density of the sphere; r = radius). The applicability to liquid-drops is discussed. AUTHOR.

See also Abstract

79B. Effects of Yaw on Vane Anemometers. R. H. Heald and P. S. Ballif.

KINETIC THEORY OF MATTER.

54. Kinetic Theory of Fluids. S. C. Bradford. *Phys. Soc., Proc.* **50.** *pp.* **30–58**; *Disc.,* **58–62,** *Jan.* **1, 1938.**—The kinetic theory is applied to the properties of real fluids by including the effect of molecular attraction. The observed properties of individual substances are calculated directly by pure dynamics from the attraction of their ultimate particles, thermal agitation and volume only, without the introduction of any arbitrary factors. The mutual attraction of the molecules of real substances increases their mean square velocity. Maxwell's law is modified by the introduction of a parameter λ which multiplies the most probable speed of the molecules, λ being the ratio of the most probable speed in a real fluid to that in an ideal gas. Other necessary consequences of molecular attraction are that all real gases and liquids are associated; there is at every interface an adsorbed layer which modifies the average effect of the transfer of momentum in collision, and there is a change of energy, due to variation of λ, in passing from one medium into another. These effects have been calculated. In order to apply the results, a law of force must be adopted. Edser's inverse-eighth-power law is found to hold. The method is applicable to all the physical properties of fluids and is applied, by way of example, to the equation of state of a gas and the vapour pressure and viscosity of a liquid with satisfactory results. The new theory explains the observed decrease of viscosity of liquids with temperature, without which no theory can be accepted. AUTHOR.

See also Abstracts 42, 244, 258, 296, 386.

LENGTH, AREA AND VOLUME.

***55. Size of Caliper Gauges. G. Berndt.** *Zeits. f. Instrumentenk.* 57. *pp.* 429–438, *Nov.*, 1937.—The paper deals with the accuracy of caliper gauges. Eight 40 mm. gauges, of different materials, and with different types of surface finish, were measured by three different observers. The results are given in tabular form, and their differences compared and discussed. This is followed by a comparison of eight other gauges made by different firms, and the influence of the gauge shape in resisting distortion to bending is examined. The lack of parallelism of the surfaces is also investigated, under two conditions of stress, and the differences between the stressed and unstressed dimensions of the gauges are compared; the effect of surface finish upon friction is also investigated. It is concluded that the usual steel caliper gauge, with lapped surfaces, is sufficiently accurate, especially when expansion due to normal temperature changes is taken into consideration. R. H. G.

See also Abstract 180 and

92B. Electrical Gauges in Measurement and Control. P. K. Hermann.

MATHEMATICAL METHODS AND THEORY OF MEASUREMENTS.

56. Fourier Expansions Obtained Operationally. N. W. McLachlan. *Phil. Mag.* 24. *pp.* 1055–1058, *Dec.*, 1937.

57. Operational Representations of Products of Parabolic Cylinder Functions and Products of Laguerre Polynomials. W. T. Howell. *Phil. Mag.* 24. *pp.* 1082–1093, *Dec.*, 1937.

***58. Mechanical Analyser for the Solution of Secular Equations and the Calculation of Molecular Vibration Frequencies. D. P. MacDougall and E. B. Wilson, Jr.** *J. Chem. Phys.* 5. *pp.* 940–944, *Dec.*, 1937.—A set of coupled harmonic oscillators has been constructed, so designed that it can be used to solve the numerical secular equations occurring in the theory of the vibration of polyatomic molecules and in other problems. Each oscillator consists of a shaft with cross arms carrying weights to increase the moment of inertia and springs to provide restoring force. The unit is free to rotate about the axis of the shaft, except for the restoring force of the springs. The various units are connected to one another by additional springs. In operation the springs and weights are adjusted to values which represent the coefficients of the secular equation to be solved, the whole device is driven by an eccentric of variable speed, and the frequencies of resonance, representing the roots of the equation, are measured. AUTHORS.

See also Abstracts 2, 60, 262.

MECHANICS, CLASSICAL.

59. Equilibrium of Convex Surfaces. F. Aimond. *Comptes Rendus,* 205. *pp.* 836–838, *Nov.* 8, 1937.—A number of results for the equilibrium of a flexible inextensible convex surface are given in quite general terms. W. G. B.

60. Table of Catenary Elements. F. P. Witmer. *Frank. Inst., J.* 224. *pp.* 633–644, *Nov.*, 1937.—To facilitate calculations on the catenary, the author has prepared tables giving the horizontal distance x, the vertical distance y, and the length of the arc l, and the three ratios x/l, y/l, y/x, in terms of the parameter c, as unit, with the angle of inclination as argument increasing from 44° to 90° at interval 10′, the values being given to six decimals. The use of the tables to solve practical problems is illustrated by worked examples. W. G. B.

***61. Projection Apparatus for Compounding Harmonic Vibrations. R. M. Archer.** *Journ. Sci. Instruments,* 14. *pp.* 408–410, *Dec.*, 1937.—Apparatus is described by which two or more simple harmonic motions may be combined optically with any desired amplitudes and phases, and both Lissajous' figures and the combinations of a wave with one or more of its harmonics may be demonstrated. Light from a point source after successive reflections from plane mirrors mounted to vibrate or rotate, is focussed on a screen as usual, but the motion of the mirrors is controlled both as to phase and amplitude by intermittent currents obtained from a rotating interrupter. AUTHOR.

MECHANICS, QUANTUM.

62. Dirac's Matrices. R. L. Gomes. *Accad. Lincei. Atti,* 26. *pp.* 75–81, *Aug.*, 1937. *In French.*—The author gives simple demonstrations of some of the fundamental properties of a system of matrices A_i which satisfies the equations of Dirac, $A_iA_j + A_jA_i = 2\delta_{ij}$. A. J. McC.

63. Dirac's Function $\delta(x)$. M. Schönberg. *Accad. Lincei, Atti.* 26. *pp.* 81–83, *Aug. and pp.* 151–153, *Sept.*, 1937.—It is shown that Dirac's improper δ function can be replaced by a single Stieltjes integral and that the derived function $\delta'(x)$ can be replaced by a double Stieltjes integral; also that the derivation to any order can be replaced by a certain double Stieltjes integral. A. J. McC.

64. Wave Functions for Large Arguments by the Amplitude-Phase Method. J. A. Wheeler. *Phys. Rev.* 52. *pp.* 1123–1127, *Dec.* 1, 1937.—The two independent solutions of the radial wave equation required in the treatment of collision problems may be expressed in terms of a common amplitude and phases differing by $\pi/2$, following a method due to Milne. The determination of phase shifts is simplified by this procedure. Analytical expressions for the amplitude and phase and their derivatives are given in the case of zero field for $L = 0, 1, 2, 3, 4$. In other cases these quantities may rapidly be determined for large arguments by numerical integration of two equations. Values of the amplitude and phase of the coulomb functions needed in the treatment of the scattering of alpha-particles in helium for $L = 0$ and $L = 2$ were obtained in this way and are tabulated. AUTHOR.

65. Quantum Theory of Polarisability of Atoms and Ions in the Inhomogeneous Electric Field. H. Hellmann and S. J. Pschejetzkij. *Acta Physicochimica*, 7. 4. *pp.* 621–645, 1937. *In German.*—The methods in the literature for the extrapolation of the ordinary polarisability of an atom with closed outer shell to the effective polarisability in the inhomogeneous field of a point charge, are critically reviewed. A new method of approximation is adopted by use of a simplified atomic model which corresponds to the actual atom with respect to susceptibility, charge distribution and polarisability. The results obtained support the Kirkwood ionic model for HCl, although the accuracy of such calculations is carefully examined. The application of these approximation methods to the calculation of the dispersion forces at short distances appears to be full of promise. An ionic model for H_2O leads also by consideration of the inhomogeneity of the field to an acute angle between the OH-directions and is contradictory to experience. H. H. Ho.

66. Dissociation of the Degenerate Gas. A. B. Severny and N. N. Tunitzky. *Phys. Zeits. d. Sowjetunion*, 12. 3. *pp.* 330–333, 1937. *In English.*—In this paper are given the conditions of equilibrium in the reaction of degenerate gas subordinated to the Fermi-Dirac and Bose-Einstein statistics. AUTHORS.

See also Abstracts 12, 144, 221, 258, 331, 332, 340, 341.

PHILOSOPHY OF SCIENTIFIC METHOD.

67. Unity of Physical Theory. J. L. Destouches. *Comptes Rendus*, 205. *pp.* 843–846, *Nov.* 8, 1937.—A general discussion of the proposition: "Given two physical theories, there always exists a theory which unites them." No method is given, however, for constructing the unifying theory in practical cases. G. C. McV.

PRESSURE.

***68. Simple Knudsen Gauge. A. L. Hughes.** *Rev. Sci. Instruments*, 8. *pp.* 409–412, *Nov.*, 1937.—A simple form of Knudsen gauge is developed in which a thin strip of Al leaf is suspended from its upper end in the middle of a glass tube whose axis is vertical. Alongside the Al leaf is mounted a Pt strip which can be heated electrically. In the presence of gas at low pressure, the Al leaf is pushed away from the heated strip because the molecules hitting it on the side facing the heated strip impart to it more momentum than those hitting it on the other side. The deflection of the Al leaf, which can be measured by a microscope with a scale in the eyepiece, is a function of the pressure of the gas, and consequently by suitable calibration, the device may be made to measure pressure. By varying the heating current through the Pt strip a wide variety of sensitivities can be readily obtained. Sensitivities ranging from 1 eyepiece scale division $= 3\cdot2 \times 10^{-7}$ mm. to 1 eyepiece scale division $= 304 \times 10^{-7}$ mm. have been used. The upper limit at which the gauge will work satisfactorily is approximately 0·01 mm. AUTHOR.

See also Abstracts 9, 194, 248, 356.

RELATIVITY AND ETHER.

69. Deflection of Light Rays in the Sun's Gravitational Field. A. v. Brunn and H. v. Klüber. *Zeits. f. Astrophysik*, 14. 4. *pp.* 242–250, 1937.—The results obtained with the horizontal double camera used by the

Potsdam eclipse expedition to Sumatra in 1929 are again examined to discover the cause of the discrepancy between the value actually found for the deflection [see Abstracts 360 (1932) and 2809 (1933)] and that predicted by the theory of relativity. There exists no criterion for the detection of systematic optical or photographic errors introduced by either the method or the apparatus used at the eclipse. Nevertheless the authors believe that such sources of error did not in fact affect the results enough to explain the discrepancy, nor can systematic error in the method of reduction be blamed. Experience at the eclipse suggests for future occasions certain technical modifications which should increase the accuracy of the results obtained. A. Hu.

SOLUTION.

70. Experimental Tests of Salting-Out Theories. P. S. Albright. *Am. Chem. Soc., J.* 59. *pp.* 2098–2104, *Nov.*, 1937.—Dielectric constant data have been obtained at several temperatures for aqueous solutions of acetone, aniline, ethyl ether, glycerol, glycine, and urea. Density determinations have been made at 25° for the solutions containing acetone, aniline, glycine, and urea. These data and the Debye theory of the salting-out effect make possible calculations of the limiting slopes of the solubility curves for the non-electrolyte solutes as a function of salt concentration. In this report attention has been confined largely to systems containing aniline and ethyl ether. The dielectric constant measurements are found to lead to calculated solubilities in good agreement with those actually observed in the more dilute salt solutions and when larger differences appear they seem to be due in considerable measure to the fact that the solubility measurements have been made in a salt concentration range too high for the limiting law of the theory. The data are most successful in that they contribute to the establishment of the essential correctness of the Debye theory which describes the primary salting-out in terms of the relative electrical susceptibility of the non-electrolyte components and the electrical fields of force in the neighbourhood of the ions. AUTHOR.

71. Solubility of D_2 and H_2 in Solid Pd. A. Sieverts and W. Danz. *Zeits. f. phys. Chem.* 38. *Abt.B.*1. *pp.* 46–60, 1937.—Isobars of solubility of D_2 and H_2 in Pd sponge were determined between 20° and 350° and the corresponding isotherms at 80°, 100°, 120° and 300°. D_2 behaves like H_2 in forming with Pd an α-phase of low D_2 (or H_2) content at high temperatures and a β-phase of high D_2 (or H_2) content at low temperatures, but the transition from α to β (which shows hysteresis) occurs over a lower temperature range, *viz.* D_2, 80°–105°; H_2, 125°–145°. Between these temperature ranges, the solubility of D_2 in Pd falls to only a few per cent of that of H_2, thus indicating a means of separating D_2 from H_2. [See Abstract 5438 (1936).] L. V. C.

72. Incomplete Solubility of Liquid Iodine in Carbon Tetrachloride. J. H. Hildebrand. *Am. Chem. Soc., J.* 59. *pp.* 2083–2085. *Nov.*, 1937.—The predicted existence of a two-liquid phase system in the case of I_2 and CCl_4 has been verified, the critical solution temperature being 160·5° and the corresponding composition, 0·68 mol.% of I_2. The correlation between the solubility of I_2 in the solid and liquid states is discussed. [See also Abstract 2866 (1935).] AUTHOR.

73. Solubilities of $CuSO_4$ and $SrCl_2$ in D_2O. F. T. Miles and A. W. C. Menzies. *Am. Chem. Soc., J.* 59. *pp.* 2392–2395, *Nov.*, 1937.—The solubilities of $CuSO_4$ and of $SrCl_2$ deuterates in D_2O are reported in the ranges from 2·7 to 110° and from 0 to 145°, respectively. Transition temperatures are determined of $CuSO_4$, $5D_2O$ to $CuSO_4$, $3D_2O$, of $SrCl_2$, $6D_2O$ to $SrCl_2$, 2 D_2O and $SrCl_2$, $2D_2O$ to $SrCl_2$, D_2O. These values are compared with the corresponding values in ordinary water. AUTHORS.

74. Transition Temperature of Gypsum to Anhydrite. A. E. Hill. *Am. Chem. Soc., J.* 59. *pp.* 2242–2244, *Nov.*, 1937.—The solubility of anhydrite in water has been determined at 65, 45 and 35°, with approach from both supersaturation and undersaturation. Using these data and previously existing data, a solubility curve can be drawn between the temperatures of 20 and 100°; the curve cuts the well authenticated curve for gypsum at 42°, placing the transition temperature some 20° lower than van't Hoff's figure of 63·5–66°. AUTHOR.

See also Abstracts 94, 249.

SURFACE PROPERTIES.

75. Special Type of Reciprocal Effect of Molecules in the Adsorption Layer. N. I. Kobosev and J. Goldfeld. *Acta Physicochimica* 7. 4. *pp.* 495–520, 1937. *In German.*—A thermodynamical analysis of the processes of gaseous adsorption by a solid body has been carried out, when it was found that in the general case the adsorption of a molecule at a given centre must alter the adsorption potential at neighbouring centres. The special hypothesis is advanced that in the typical case the reduction of the adsorption potential within a given region is around the adsorbing molecule. It is shown that such a polarisation of the surface must lead to the development of repulsive forces between the molecules in the adsorption layer, whereby these forces can appreciably exceed the direct polarisation reciprocal effects. These repulsion forces are shown to lead to: (*a*) deviation from the equation of state of the ideal (Volmer) two-dimensional gas; (*b*) increase of the chemical potential of the real gas in comparison with the ideal and to its more rapid growth with increase of surface concentration; (*c*) a pronounced change of the appearance of the Langmuir adsorption isotherm; (*d*) a deviation of the desorption kinetics; (*e*) a change of mechanism of the exchange adsorption. It is shown that the conception now developed can be useful for the study of these surface phenomena which are connected with the energy of the adsorption bond, especially with the phenomena of kathodic overvoltage, with catalysis and electrocatalysis, with exchange and surface diffusion, and with thermo- and photoelectronic emission. H. H. Ho.

***76. Separation of Fluorine from Oxygen by Adsorption and Rectification. E. Kanda.** *Chem. Soc. Japan, Bull.* 12. *pp.* 458–462, *Oct.*, 1937.—The possibility of separating F from O_2 by adsorption on charcoal at low temperatures was investigated. O_2 was adsorbed on charcoal in greater quantity than F at all temperatures used (0° to −183°). The difference in the amounts adsorbed is greater the lower is the temperature. The process gave 99·4% F from 96% F after six adsorptions. A rectifier is described for separating F and O_2. By its use 99% F could be obtained from a liquid containing 95% F. A. J. M.

77. Adsorption of Gases in an Electric Field. O. Blüh. *Zeits. f. Physik*, 107. 5–6. *pp.* 369–381, 1937.—A mixture of H_2 and CO_2 or H_2

and SO_2 is passed over a condenser consisting of carefully polished and degassed Al plates. By measuring the thermal conductivity of the mixture the H_2 content can be found and since practically no H_2 is adsorbed, the amount of the heavier gas adsorbed can therefore be deduced. It is found that the adsorbed amount is considerably increased if there is a field of 17,000 V/cm. in the condenser. R. P.

78. Wetting and Corrosion of Metals in Polyphase Systems. Part IV. D. I. Mirlis. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 16. 5. *pp.* 273–280, 1937. *In English.*—The effect of selective linear corrosion of Fe along the 3-phase boundary line in the equilibrium systems Fe-aq. sol. of R.COOH-benzene or air, is both reduced and qualitatively altered as the length of the hydrocarbon chain increases in the fatty acid series. In similar circumstances the corrosion of Fe in the aqueous phase of the system Fe-aq. sol. of R.COOH-benzene is also reduced. The corrosion of Fe in the benzene as well as in the gaseous phases of polyphase systems is enhanced on passing from the lower to the higher members, though butyric acid presents an exception. In the systems Fe-aq. sol. CH_3CH_2COOH-benzene small drops of the aqueous phase are found after a time uniformly distributed along the boundaries of the crystallites where corrosion is mainly localised, and an explanation of this is put forward. [For Part III see Abstract 4372 (1937).] P. H. B.

79. Surface Tension of Aqueous Soap Solutions. F. A. Long, G. C. Nutting and W. D. Harkins. *Am. Chem. Soc., J.* 59. *pp.* 2197–2203, *Nov.,* 1937.—An investigation of the effect of pH on the surface tension of solutions of sodium laurate and sodium nonylate shows that the surface tension is relatively high in basic and low in neutral solutions. This agrees with the idea that the long chain paraffin ions together with the electrostatically held positive " gegen " ions are adsorbed from the strongly basic solutions, while the much more surface active acid is adsorbed more greatly from the slightly basic or neutral solutions. The presence of electrolytes, such as neutral salts, is found to lower greatly the surface tension, especially in the basic solutions. This indicates either that the adsorbed constituent is made more highly surface active, as by an effect upon the ionic atmosphere of the positive gegen ions, or there is an increase in the activity in the solution of the constituent which is adsorbed, or the nature of one of the adsorbed constituents is changed. The effect is not related in a simple way to the ionic strength, but exhibits a simple relation to the concentration of the electrolyte. AUTHORS.

80. Adsorption and Surface Structure. J. H. de Boer and J. F. H. Custers. *Physica,* 4. *pp.* 1017–1024, *Nov.,* 1937. *In English.*—Adsorption of gases or vapours takes place in many cases by means of non-polar van der Waals forces. In order to obtain the required adsorption energy the surface must be porous. In the case of I_2 and Cs deposited on surfaces of alkaline-earth salts obtained by sublimation *in vacuo,* examination of the absorption spectra shows that in addition to those molecules attached by van der Waals forces, a smaller number are attached by electrostatic forces. Layers of alkali metal halides and alkaline-earth halides deposited by sublimation in a high vacuum are very porous and possess a laminated structure. Films of silica, alumina, and zirconia obtained by the same method are not porous, and do not visibly adsorb I_2 or Cs, though a small amount of adsorption was detected by means of the absorption spectra. This latter was not van der Waals adsorption. The porosity of a surface depends on the method of sublimation. Silica layers prepared by sublimation in an atmosphere of A (0·2 mm. pressure) would adsorb I_2. [See Abstract 2243 (1934).] A. J. M.

81. Structures of Iron Films Deposited on Crystals of Alkali Halides. S. Shirai. *Phys. Math. Soc., Japan, Proc.* 19. *pp.* 937–944, *Oct.*, 1937. *In English.*—This paper describes the preparation of thin films of iron prepared by evaporation *in vacuo* upon the cleared surfaces of some alkali halide crystals of NaCl type at temperatures ranging from 300° to 600° C. The crystals used as the bases were rock-salt, NaCl, KCl, KBr and KI; except for natural rock-salt, the crystals were prepared by slow cooling from the molten salt, and the structures of the films were investigated by the method of kathode-rays. It was found that films made on the bases at temperatures higher than a certain value gave patterns of oriented crystals, whereas those made below this point gave the Debye-Scherrer rings. The films made at the same time on different blocks of the same crystal gave generally the same pattern, but those made at the same time on crystals of different kinds always gave different patterns indicating distinctly the effect of the crystals employed for the bases. The phenomena are very fully discussed and illustrations are included. H. H. Ho.

82. Structural Investigation of Evaporated Metal Films. O. Rüdiger. *Ann. d. Physik*, 30. 6. *pp.* 505–526, *Nov.*, 1937.—Au, Ag and Pd were evaporated on to various substrates which were maintained at an elevated temperature. It was found by electron diffraction that above a certain temperature of deposition which was characteristic of the metal/substrate combination, the metal crystals become oriented. The orientation is not uniform throughout the films but is usually best at the surface of the metal, although if the substrate temperature is sufficiently high even the layers in immediate contact with the substrate are well oriented. With a calcite substrate the orientation is successively (111), (100) and (110) as the temperature is raised, whereas with a quartz substrate no well-defined orientation is ever achieved. The degree of orientation does not always increase with temperature, but with Au is a maximum at 450° – 580° C. Finally, it was shown that the surface of polished quartz is much less rough than that of polished copper. A. G. Q.

83. Surface Structure of Liquid Mercury. G. L. J. Bailey, S. Fordham and J. T. Tyson. *Phys. Soc., Proc.* 50. *pp.* 63–69, *Jan.* 1, 1938.—Previous workers have obtained by electron-diffraction from liquid-mercury surfaces either evidence of a crystalline structure, which they attributed to the mercury, or inconclusive results in that only incoherent scattering was observed. The present work explains these discrepancies and shows that liquid-mercury surfaces are in reality amorphous, but are generally covered with a thin crystalline film of some adventitious impurity. AUTHORS.

84. Parachor of NO_3F. D. G. Hill and L. A. Bigelow. *Am. Chem. Soc., J.* 59. *pp.* 2127–2128, *Nov.*, 1937.—The surface tension of liquid NO_3F is determined and the parachor calculated. The structure of the compound is discussed. AUTHORS.

85. Monomolecular Layers. D. G. Dervichian. *Ann. de Physique*, 8. *pp.* 361–466, *Nov.*, 1937.—Film-covered surfaces were gradually reduced in area by a mechanism which produced a proportional rotation in a cylinder covered with photographic paper on which the surface tension and the potential across the films were automatically recorded. Continuous and quantitative records of the simultaneous variations of surface area,

V. 19

surface tension and potential were thus obtained. Discontinuities and points of inflexion were clear. Several combinations of substances were investigated and measurements were carried out at various temperatures. The changes of state in the surface layers are discussed at some length. It is deduced that a saturated monomolecular film is, in structure and concentration, a reproduction of the surface of the liquid when in bulk. At the point of vaporisation the forces of cohesion and adhesion are equal, and an explanation of the behaviour of gaseous layers is given in terms of these forces. The action on points of affinity in the molecular film of substances dissolved in the underlying water are discussed, but this work is in progress. Finally, the author attributes the discrepancies between known dipole moments, and those calculated from the potential measurements, to a deformation of the dipole when the cohesion forces came into play, to dissociation, and to the nature of the ions present in the water. P. H. B.

86. Effect of Dissolved Salts on Insoluble Monolayers. I. Langmuir and V. J. Schaefer. *Am. Chem. Soc., J.* 59. *pp.* 2400–2414, *Nov.*, 1937.—The technique and apparatus are described for making qualitative or quantitative determinations of the adsorption of dissolved salts from aqueous solutions by a surface monolayer of an insoluble substance. The absolute viscosities of stearic acid and barium stearate monolayers on water having various pH values are listed. These show progressive changes due to adsorption of impurities. The equations and the apparatus used for measuring the viscosity or elasticity of insoluble monolayers are given. The modification of a crystallised monoskim of pure stearic acid by the adsorption of Al from water containing one part of Al in two billion parts of water has been shown by photographs. A melted monoskim of stearic acid coloured by copper adsorbed from water containing one part of Cu in three hundred million parts of water was described. Simple methods for the visual observation of the modification of pure stearic acid monolayers caused by minute concentrations of impurities in water which produce a change in the crumple pattern and crystallised monoskim have been described, together with the detection in a similar way of non-volatile impurities in volatile substances such as benzene. Equations have been given for the rate of diffusion of dissolved substances through water to an insoluble monolayer on the surface and a method is described for greatly accelerating the rate of arrival at the surface. AUTHORS.

87. Surface Phenomena and Dissociation Constant of Weak Electrolytes. B. Kamieński. *Acad. Polonaise Sci. et Lettres, Bull.* 6–8*A. pp.* 422–429, *June–Oct.*, 1937. *In English.*—Typical examples of the influence of the H- ion concentration on the dielectric potential, surface tension, and adsorption of dissolved organic compounds are represented. Thus, organic acids are adsorbed greatly from acid aqueous solution, and bases from alkaline solutions ; these compounds show the greatest decrease of the dielectric potential and surface tension at the respective H-ion concentrations. Amphoteric electrolytes may exhibit a minimum or maximum adsorption change of dielectric potential and surface tension. Two types of iso-electric points are foreseen, one with a maximum capillary activity, the other with a minimum activity. A quantitative relation is given between the dissociation constant and the points of inflexion of surface phenomena at different H-ion concentration. This relation allows a maximum or minimum of capillary activity to be foreseen when right values of the dissociation constants are known, and the dissociation constants to be calculated when the dielectric potential, surface tension, or adsorption at different H-ion concentrations are gauged. Examples of the calculation are quoted. [See also Abstract 3332 (1935) and following Abstract.] AUTHOR.

88. Dielectric Potential and Surface Tension. B. Kamieński. *Acad. Polonaise Sci. et Lettres, Bull.* 6–8*A*. *pp.* 430–440, *June–Oct.*, 1937. *In English.*—On the basis of former extensive gaugings and considerations a hypothesis is suggested that the orientation of water dipoles is the most important factor in building the potential drop at the water-air interface. The number of the orientated water dipoles decreases when capillary active substances are added. The electric work of the dielectric potential, besides that of the surface tension, is added to the work in thermodynamical potential, the variation of the internal energy at the interface is considered, and Euler's theorem is applied. A differential equation results which is interpreted by the author on the basis of former equations. From these it follows that when the number of the orientated dipoles decreases, a change of the dielectric constant at the interface takes place. A number of parallel measurements of the surface tension change (abscissæ) and of the dielectric potential change (ordinates) is shown graphically. From this it follows that the function is very intricate and that it depends on the electrochemical behaviour and capillary activity of the solute. Nevertheless, change of the dielectric potential with decreasing surface tension exhibits regularities and the maximal change of the dielectric potential is of the type of an adsorption curve. Thus, the potential drop at the water-air interface may be estimated as 600 to 1100 mV by extrapolation. [See also Abstract 1071 (1937) and preceding Abstract.] AUTHOR.

***89. Vertical and Horizontal Film Balances. W. D. Harkins and T. F. Anderson.** *Am. Chem. Soc.*, *J.* 59. *pp.* 2189–2197, *Nov.*, 1937.—By a modification of Wilhelmy's method, in which the vertical pull is balanced against the buoyancy of the liquid, the surface tension of a film was measured continuously as the film was compressed. Only quartz was brought into contact with the liquid so that the effect of minute quantities of metallic ions could be investigated. It was found that the Ca^{++} ion compresses fatty acid ions of the film and eliminates the expanded region obtained without it. The mathematical theory of the ordinary horizontal pull film balance is developed, and data are presented which show that the two types of film balance give essentially the same values of the surface pressure with either liquid or solid films, even if the latter are extremely rigid. P. H. B.

See also Abstracts 18, 26, 161, 259.

TIME.

See Abstract

77B. Time and Frequency. V. Yanouchevsky.

VISCOSITY AND FRICTION.

90. Viscosity of Liquids. *Roy. Soc., Proc.* 163*A*. *pp.* 319–337, *Dec.* 7, 1937.—A report of a discussion.

G. I. Taylor in an opening Address (*pp.* 319–320) referred to the anomalous behaviour of some fluids as regards viscosity. Anomalous properties may be conferred by the presence of small, elongated solids in the liquid. Spherical solids, or spherical drops of another fluid do not make the fluid anisotropic with respect to viscosity.

J. D. Bernal (*pp.* 320–323) discussed the relationship between viscosity and molecular structure of pure liquids. Viscosity is connected with the rate of change of the mutual configuration of the molecules of a liquid, which has a characteristic time of the order of 10^{-6} sec. These changes of configuration when the liquid is under a shearing stress involve an intermediate state when the molecules are further apart than the normal, and therefore a certain activation energy. The phenomena of viscosity are closely linked with volume change. The law of Batchinsky that viscosity is a function of free volume is discussed.

A. S. C. Lawrence (*pp.* 323–327) discussed the viscosity of gels. Gels are composed of a meshwork of fibrils which in solution rotate and occupy a volume much greater than themselves. When the concentration is such that the total effective volume of the particles is equal to the volume of the solution, further addition of solute results in a steepening of the viscosity-concentration curve. The theory is complicated by the fact that chemically linear polymeric molecules will not necessarily be geometrically linear. Anomalous viscosity in such systems is considered in connection with rigid and non-rigid anisodimensional particles, respectively.

E. N. da C. Andrade (*pp.* 327–330) discussed the equation $\eta = 5{\cdot}1 \times 10^{-4} (AT)^{1/2}/V^{2/3}$ (A = atomic weight, T = melting point, V = gram molecular volume) which gives viscosities of the right order for all liquids and for metals with close-packed crystal structure. The variation of viscosity with temperature may be expressed by the equation $\eta v^{1/3} = Ae^{c/Tv}$. This holds very well for molten metals and many organic liquids.

E. Hatschek (*pp.* 330–334) discussed anomalous viscosity in suspensions of spherical particles. Theories proposed to explain the fact that suspensions of rigid and approximately spherical particles show a decrease in viscosity with increasing rate of shear are discussed. It can be shown that if the particles are deformed into rhombododecahedra, which in laminar flow are alternately deformed into prisms and regain their original shape, the viscosity will decrease with increasing rate of shear, and become constant. This has been confirmed experimentally by Sibree not only with emulsions, but also with froths.

R. K. Schofield (*pp.* 334–336) stated that investigation of the viscosity of flour dough shows that a further term ($-\,da/dt$), to take account of the elastic after-effect, must be added to Maxwell's equation, which then becomes $de/dt = (1/n)dS/dt - da/dt + (1/n)S$ (n = rigidity modulus, e = fractional elongation, S = shearing stress). It must not, however, be considered that the mechanism giving rise to viscosity in flour dough is similar to that causing viscosity in pure fluids. Viscosity increases with the amount of deformation under constant stress, and it is less the greater the stress. A. J. M.

***91. Viscosity of Fluorine Gas at Low Temperatures. E. Kanda.** *Chem. Soc. Japan, Bull.* 12. *pp.* 463–468, *Oct.,* 1937.—A modification of Vogel's viscometer (using the determination of the decrement of the oscillation-rotation of a disc) is described, and used for the determination of the viscosity of F at temperatures between 0° and −186°. The method was checked by first determining the viscosity of H_2. The coefficient of viscosity of F is 2093 ± 10^{-7} at 0°, and 555 ± 10^{-7} at −186°. Sutherland's constant, C, is 129, the diameter of the molecule is 3·02 Å, and the mean free path at 0° is $9{\cdot}12 \times 10^{-6}$ cm. A. J. M.

92. Influence of Temperature and Specific Volume on the Viscosity of Liquids. W. R. van Wijk and W. A. Seeder. *Physica,* 4. *pp.* 1073–1088, *Nov.,* 1937. *In English.*—The experimental formulæ which express the dependence of the viscosity on the temperature may be divided into two classes. In the formulæ of the first class the temperature is indirectly taken into account only, viz. through the expansion of the liquid. In the formulæ of the second class a direct influence of the temperature is supposed to exist. Further, there exist some relations which have been deduced from the kinetic theory. The coexistence of these different classes of relations is explained from the internal structure of the liquid. It runs parallel with the dependence of the local density on the temperature. This local density in the case of non-configurational liquids mainly depends on the volume only, but in the case of configurational liquids is also directly dependent on the temperature. A formula is given for the viscosity of liquid or gas, applicable to the measurements under atmospheric and elevated pressure, and showing the difference between configurational and non-configurational liquids. AUTHORS.

93. Temperature-Variation of Viscosity of Strongly Associated Liquids. B. Derjaguin and M. Kussakow. *Acta Physicochimica*, 7. 3. *pp.* 459–466, 1937. *In German.*—The viscosities of twelve tractor oils, from 0°–140° C., were somewhat more accurately represented by the formula of Vogel-Fulcher-Tammann, log $(\eta/\eta_0) = C/(t - t_0)$, than by le Chatelier's formula, log log $(\eta/\eta_0) = A - Bt$. The presence in these formulæ of three parameters, as compared with two in Batschinski's equation (which applies to non-associated liquids) is due, it is suggested, to the variability of degree of association with temperature. L. V. C.

94. Viscosity of Aqueous Solutions of Electrolytes. Part III. H. Tollert. *Zeits. f. phys. Chem.* 180. *Abt.A.* 5. *pp.* 383–391, 1937.—The specific ionic viscosities at 20° and 25° of H, Na, K, OH, and Cl ions in the concentration range 10^{-4} to 1 *N* are calculated. The curves of specific ionic viscosity against concentration for the OH and H ions show inflexions at concentrations between $0{\cdot}5 \times 10^{-2}$ and 2×10^{-2} *N*, but outside this range the variation is linear. The curves for the remaining ions show small anomalies in this range, which are greater at 25° than at 20°, and are displaced to 2×10^{-3} to 5×10^{-3} *N* for the lower temperature. The specific ionic viscosities of Na and K ions are the same over this range. It is shown that the phenomenon of negative ionic viscosity is normal, and that of positive ionic viscosity abnormal. [For Part II see Abstract 4494 (1935).] A. J. M.

***95. Overflow Viscometer. I. Sakurada and N. Saito.** *Kolloid Zeits.* 81. *pp.* 208–212, *Nov.*, 1937.—A modification of the Ostwald viscometer in which, by means of an overflow arrangement, the pressure head remains the same so that dilution and other operations can be performed without removing the liquid from the viscometer, is described. The instrument was used to determine the solubility of nitrocellulose in butyl acetate-benzene, and butyl acetate-acetone mixtures, and the stability of the solutions. The results agree well with those obtained by a nephelometric method. A. J. M.

See also Abstracts 54, 315.

ASTRONOMY AND ASTROPHYSICS.

COMETS AND METEORS.

96. Comet Wolf I in 1933 to 1934. M. Kamieński and M. Bielicki. *Acad. Polonaise Sci. et Lettres, Bull.* 3–5 *A. pp.* 121–130, *March–May*, 1937. *In German.*—From observations of 1884, 1918/9, and 1925, and the calculated perturbations by Jupiter and Saturn since the latest date, the ephemerides of this comet were calculated and its return was predicted. On July 25, 1933, Jeffers photographed it at Lick Observatory, and it was observed until Dec. 1934, looking like a faint round nebula hardly $3''$ to $4''$ in diameter. Its magnitude in 1925 had been 14, in 1933/4 it was less than 18, and at its next perihelion passage in July 1942 it will be 21^m or 22^m, invisible even in the 200-in. telescope on Mt. Palomar. Yet its apparitions have been of scientific importance, since up to the last it returned punctually to its predicted place. M. A. E.

97. Cosmic Nature of Telescopic Meteors. I. S. Astapowitsch. *Observatory*, 60. *pp.* 285–289, *Nov.*, 1937.—The large number of hyperbolic velocities found for telescopic meteors and the general increase of velocity with decrease of brightness are pointed out. Analysis of the different classes into which telescopic meteors fall suggests that the origin of many of them is to be found in the dark nebulæ. G. C. McV.

COSMOGONY.

98. Nebular Counts and Hyperbolic Space. G. C. McVittie. *Zeits. f. Astrophysik*, 14. 4. *pp.* 274–284, 1937. *In English.*—The method proposed by the author for interpreting the counts of extra-galactic nebulæ by means of the expanding universes of general relativity has been criticised by Hubble [see Abstract 3444 (1937)] on the ground that the method used for extrapolating the velocity-distance relation to the great depths of space was unsatisfactory. It is now shown that, using Hubble's own method of extrapolation, hyperbolic universes are arrived at as before. The radius of curvature of space is some 10^9 parsecs., the density of matter is of the order of 10^{-30} gm./cm^3. and the cosmical constant has the value of about 7×10^{-34} sec^{-2}. Allowance is made, in arriving at these results, for the probable errors in the various observational constants. G. C. McV.

NEBULÆ.

99. Interpretation of Hagen's Clouds. H. Siedentopf. *Zeits. f. Astrophysik*, 14. 4. *pp.* 293–296, 1937.—It is suggested that the obscuring effect of the dark galactic clouds is best determined by visual observations of the illumination of the interstellar background at the galactic plane and at the poles respectively. Quantitative results can be based on Kuhl's theory of light-perception. G. C. McV.

See also Abstracts 98, 204.

PLANETS.

100. Mercury's Transit across the Corona. B. Lyot. *Comptes Rendus*, 205. *pp.* 895–896, *Nov.* 15, 1937.—The author used the 20 cm. coronagraph emplaced on Pic du Midi for the observation of Mercury's passage across the corona south of the sun on 1937 May 11. It was seen projected on a prominence at $10^h\ 15^m$, and its passage was followed across this until $10^h\ 37^m$, and subsequently across the corona, but its disc disappeared at $11^h\ 10^m$. The 22 exposures were made on panchromatic Guilleminot plates 200 H and D, through a red filter with exposure times of 1 to 3 sec. Some plates were striated by cirrus clouds. There was no bright border to Mercury's limb at all, so that its atmosphere must be extremely sparse and feebly diffused; its depth cannot exceed a few hundred metres. A. S. D. M.

STARS.

101. Colour Indices of O and B Stars and Selective Absorption of Light in Space. J. Dufay and Ssu-Piu Liau. *Comptes Rendus*, 205. *pp.* 787–789, *Nov.* 3, 1937.—The authors continue their previous research [see Abstract 3410 (1933)]. Distances (r) are evaluated without the intervention of either absolute (M) or apparent (m) magnitudes, through the marked correlation between C and the intensity of interstellar K. For the 61 stars common to the lists of Becker and Plaskett, the distances (r') are calculated; then by means of the apparent (m), the corresponding absolute magnitudes (M') are found, and give for the correlation between C and r', a coefficient $R = +0{\cdot}470 \pm 0{\cdot}101$, of the same order as that between C and m, but a negligible correlation between C and M' ($R = -0{\cdot}107 \pm 0{\cdot}128$). So, too, between the distances, r and r', the correlation coefficient is of the same order as that between M and M', but the two systems are not coincident. When K intensity is taken as criterion of distance for O and B stars, the coefficient of selective absorption becomes, to a great degree, indeterminate. A. S. D. M.

102. Intensity Effect on Colour Temperature. W. Becker and G. Hartwig. *Zeits. f. Astrophysik*, 14. 4. *pp.* 259–273, 1937.—The infrared colour indices determined at Yale are compared with the Babelsberg indices for the blue-violet region of the spectrum. Excluding the B-stars, the former indices are from 30 to 50% smaller than the latter owing to the absorption regions found in the blue-violet part of the spectrum. The C-stars show the same type of intensity-effect as the normal stars. G. C. McV.

103. Mass-Luminosity Relation. É. Sevin. *Comptes Rendus*, 205. *pp.* 723–725, *Oct.* 26, 1937.—The mass-luminosity relation, whilst giving satisfactory results where the relative brightness of stars is concerned, breaks down with absolute brightnesses, giving values 10 times greater than those observed. The author criticises Eddington's assumption of an internal dilution with H_2 [see Abstract 3654 (1932)] to remove the discrepancy, on the grounds that such a phenomenon would require a more delicate balancing of the constituents of a star than is at all likely. It is shown that the discrepancy cannot be rectified by a mere adjustment of absorption coefficient: the cause lies with the basic assumptions on which the mass-luminosity theory rests. The energy L_r emitted per sec. by a sphere of radius r inside a star does not, on this theory, as it must in fact, approach the total radiation L_0 as r approaches r_0, the external radius of the star: it reaches a maximum at $r = 0{\cdot}5\ r_0$ approx., and decreases to zero at $r = r_0$. A. Hu.

104. Rôle of the Source of Stellar Energy. É. Sevin. *Comptes Rendus*, 205. *pp.* 841–843, *Nov.* 8, 1937.—A stellar model in radiative equilibrium is discussed in which the rate of energy-generation is proportional to $q^2T^{\frac{1}{4}}/pP$, where q is radiation-pressure, p the material pressure,

P the total pressure and T the temperature. The mass-luminosity law deducible from this hypothesis is in agreement with observation.
G. C. McV.

105. Stability of Radiative Gradients in the Interior of a Star. S. Chandrasekhar. *Nat. Acad. Sci., Proc.* 23. *pp.* 572–577, *Nov.*, 1937.—Three assumptions are made: (1) at each instant the pressure of an expanding (or contracting) element, δm, on its surrounding material is the same as that exerted *by* the material; (2) that the expansion (or contraction) taking place is adiabatic; (3) that no viscous forces restrict the movements of δm. The author examines these assumptions separately, and then fundamentally in their mutual connections. If the radiation pressure is important—if β and $(1-\beta)$ are of comparable orders of magnitude—then the system of "convection" currents set up must be quite "violent". This makes it *a priori* probable that the inertia of motions is still quite large, entailing viscous friction (contrary to assumption) in the ascending and descending elements; thus communicating appreciable amounts of heat to the elements (contrary to assumption (2) that the processes are adiabatic); that the expansion (or contraction) of the element δm may be so considerable that assumption (1) may not in general prove to be the case. He concludes that at present no definite prediction can be made as to the nature of "convection currents" if the radiation pressure is important, and if the radiative gradient exceeds the adiabatic. A. S. D. M.

106. Properties of Eddington Model Star. W. Gleissberg. *Zeits. f. Astrophysik*, 14. 4. *pp.* 251–258, 1937.—The Eddington model is defined as one in which the condition of equilibrium is obeyed and in which the gas pressure constitutes a constant fraction of the total pressure. It is shown that these two conditions lead to a single one: a certain integral is a minimum for this model as compared with neighbouring models in which the same boundary conditions are satisfied at the centre and at the limb, and in which the distribution of mass along the radius is the same. It is shown that the Eddington model and no other fulfils the necessary and sufficient conditions for this integral to be a minimum. A. Hu.

107. Diffusion of Light in the Milky Way. J. Dufay. *Comptes Rendus*, 205. *pp.* 719–721, *Oct.* 26, 1937.—The contribution of galactic diffusion to the brightness of the night sky is investigated. From the evidence of star-counts by magnitudes, the author calculates how the diffused brilliance should vary with galactic latitude. Evidence in favour of the presence of such diffusion comes from the dark regions in the Milky Way, which are dark only by contrast, and from Struve and Elvey's observations on dark nebulæ [see Abstract 1530 (1936)]. These latter and those of Elvey and Roach [see Abstract 2500 (1937)] give numerical results agreeing fairly well with the theory. The observed brilliance, however, decreases more rapidly towards the galactic pole than the calculated; this effect is ascribed to preferential scattering. It is pointed out that the observations cannot decide whether the diffusing particles are large or small compared with the wave-length. A. Hu.

108. Galactic Rotation Constants from Open Clusters. H. Mineur. *Comptes Rendus*, 205. *pp.* 721–723, *Oct.* 26, 1937.—It is pointed out that knowledge of the distance of the centre of the galaxy rests at present on observations of globular clusters and of Cepheids in Sagittarius—observations which are incomplete and are moreover affected by interstellar absorption. Values obtained for the galactic rotation velocity similarly suffer from paucity of data. The author uses the distances and radial velocities of 42 open clusters determined at Lick to derive both quantities. From a cubic expansion for the radial velocity of a typical cluster, he derives an expression for the mean radial velocity for all the clusters. A least squares solution using the Lick data gives 6400 parsecs as the distance of the sun from the galactic centre, and 330 km./sec. as its orbital velocity. The coefficients of the cubic show that the rotation velocity reaches a maximum of 370 km./sec. at a distance of 9000 parsecs from the centre. A. Hu.

109. Photometric Study of the Variable B.D.—1°1004. J. Ellsworth. *Comptes Rendus*, 205. *pp*. 892–895, *Nov*. 15, 1937.—This B_3 type spectroscopic double has a main period of $27^d \cdot 160$ and an eccentricity $0 \cdot 76$, the line of apsides being in the line of sight. The author has made 349 visual measures (1931–1935) with a cat's eye photometer (comparison star, ϵ Orionis), and 140 observations continued throughout the whole night 1934 Nov. 22—1935 April 1) which show a minor variation of period of $0^d \cdot 440230$ with two maxima and two minima per period. He also made photographic measures (1935–1937) of the field of the variable by Liau's method [see Abstract 122 (1936)]. He concludes that BD—1°1004 is probably not an eclipsing variable, and that there is no proved relationship between the spectroscopic and the photometric periods. Its characteristics resemble variables of the β Cephei (B1) type. A. S. D. M.

110. Variable Star of Type W Ursæ Majoris in Praesepe. H. Haffner. *Zeits. f. Astrophysik*, 14. 4. *pp*. 285–292, 1937.—From 260 photographs taken in Oct. to Dec., 1936, the period and light-curve of this star have been determined. After allowing for variation caused by ellipticity, a variation of only $0^m \cdot 05$ is found for eclipse ; but from this, and from the absolute magnitude of $+4^m \cdot 8$, the configuration of the system can be approximately deduced. Each component has a mass about equal to that of the sun, but a density twice as great, and they revolve with their surfaces at a distance from one another less than the sun's radius. M. A. E.

111. Photographic Observations of Nova Lacertæ, 1936. P. Rossier. *Arch. des Sciences*, 19. *pp*. 181–195, *July–Aug*., 1937.—Photometric comparisons are made with HD 211336 (ϵ Cephei) and HD 211430, by the diameter method. A detailed description is given of the spectrograms. Both emission and absorption spectra appear, their difference being from 20 to 30 Å—a radial velocity of about 2000 km./sec. Tables are given of the widths of emission rays of H, and of their maximum blackening on the microphotograms, also of emission (H, O) rays with respect to the continuous background. It is concluded that the original outburst was on June 13. A. S. D. M.

SUN.

112. Solar Wave-Length Displacements Observed at the Japan Eclipse of June 19, 1936. T. Royds. *Roy. Astron. Soc., M.N.* 97. *pp*. 692–695, *Oct*., 1937. *Supplement*.—The summary is given of displacements at the centre of the sun's disc and near the limb both with and without eclipse. Both at the centre and at the limb there is no significant difference in the eclipse spectra from those taken in full sunlight. The differential shift between different intensity groups is maintained in eclipse spectra, showing that the effect of scattering in full sunlight does not appreciably affect the wave-lengths of lines as weak as intensity 3 up to points $0 \cdot 98$ radii from the centre of the sun. Hence the results show that the differences observed in full sunlight in the limb shifts of different intensity groups are not due to scattering of general sunlight into the limb spectrum, but must be taken to be real, and consequently that the relativity theory, or any other theory requiring a general displacement of solar wave-lengths, is not adequate to furnish a complete explanation of solar displacements. AUTHOR.

See also Abstracts 100, 370, 371, 372.

GEOPHYSICS.

GEODESY.

113. Determination of the Earth's Plasticity from the Post-Glacial Uplift of Scandinavia; Isostatic Adjustment. F. A. V. Meinesz. *K. Akad. Amsterdam, Proc.* 40. 8. *pp.* 654–662, 1937.—Reference is made to differences in the value of the coefficient of viscosity (η) obtained by Haskell and by van Bemmelen and Berlage from post-glacial uplift after the removal of the ice load. Three sources of evidence are considered and assuming equilibrium is not yet attained η is found to be 3×10^{22}. The time of disappearance of the half depression is found and from this data are obtained relating to the plasticity of the earth. R. S. R.

HYDROSPHERE, PHYSICS OF THE.

114. Seiches in a Strait Connecting Two Seas. G. R. Goldsbrough. *Roy. Soc., Proc.* 164*A*. *pp.* 1–15, *Jan.* 7, 1938.—The problem studied is that of the natural vibrations of the water in a strait connecting two open seas. The shores of the strait are the two branches of a hyperbola and a certain law of depth is chosen. It is shown that such a system has free modes of four distinct types characterised by symmetry about both axes, asymmetry about the conjugate axis, asymmetry about the transverse axis and asymmetry about both axes, respectively. In each case there is an infinite number of distinct modes. The waves diminish rapidly in amplitude as the channel widens. The nodal lines are members of the same family of confocal ellipses and hyperbolæ of which the shores are members. Some of the lower modes are worked out completely for special cases. But simpler approximations are given covering all the forms where the eccentricity of the bounding hyperbola is not too small. AUTHOR.

115. Total Amount of Sedimentation in the Deep Sea. P. H. Kuenen. *Am. J. Sci.* 34. *pp.* 457–468, *Dec.*, 1937.—From stratification in the "Meteor" samples Schott calculated the average rate of oceanic sedimentation as 1 cm. per 1000 years. This appears to imply a total thickness of 17 km. of sediment on the floors of the oceans and therefore a denudation of the continents of 40 km. This amount is evidently far too great. Two factors have to be introduced, however, into the speculations, namely compaction of the sediments and the production of eruptive rocks. A rough estimate then brings Schott's figures in close agreement with the production of sedimentary materials. If sedimentary layers of 5–6 km. on the ocean floor have to be assumed, it is found that several problems are thereby involved, namely: loss of water, isostasy of the oceans, temperature at the lower surface of the crust, subsidence of oceanic volcanoes, seismic propagation, Wegener's mechanism of continental drift, and the thickness of the continents. AUTHOR.

LAND, PHYSICS OF THE.

116. Size-Grading of Sand by Wind. R. A. Bagnold. *Roy. Soc., Proc.* 163*A*. *pp*. 250–264, *Nov*. 19, 1937.—The size-grading of samples of eolian sand deposits when plotted as weight per log-cent change in grain diameter against log diameter gives curves which show that the extreme grades on each side of the mean diameter die away in percentage weight according to an exponential law. The exponential coefficients on each side differ in value. These and other coefficients defined in the paper numerically describe the grading of sand in a manner independent of the usual diagrammatic representation and of the sieve sizes used in its analysis. By imitating experimentally a simple cycle of sand movement consisting of removal from a sand bed of known composition, transportation over the bed, and deposition under various conditions, the factors controlling the value of each coefficient separately have been investigated. The tendency of sand to grade itself according to the above bi-exponential pattern was confirmed by experiments with sands whose grading pattern had been artificially distorted by the addition of extra sand of certain grades. The process by which the extra sand is rejected by the mixture is described. The results are applied to the size-grading of a typical sand dune. AUTHOR.

METEOROLOGY.

117. Absorption Coefficients and Mean Temperature of Atmospheric Ozone. G. Déjardin, A. Arnulf and D. Cavassilas. *Comptes Rendus*, 205. *pp*. 809–811, *Nov*. 3, 1937.—Observations made with a quartz spectrograph at a height of 3167 m. on Mt. Blanc on 19th July, 1936, are examined. Special screens of known spectral transmission were used. The results discussed cover the interval 3326–3135 Å. Here the absorption maxima are not influenced by temperature. From the principal maxima the equivalent thickness of the ozone layer is found. In calculating the mean temperature of the ozone layer the principal minima are used. The authors find that between + 20° C. and − 80° C. the coefficients of absorption of these diminish according to a linear law. They are able in this way to find a mean temperature for the ozone layer of − 35° C. or − 45° C. according to the values of absorption coefficients used. A. E. M. G.

118. Greenhouse Effect of Volcanic Dust. W. J. Humphreys. *Monthly Weather Rev*. 65. *pp*. 261–262, *July*, 1937.—Observation has shown that the summer of 1783 was abnormally warm in western and northern Europe while the following winter was abnormally cold. The cause of the former is attributed to the presence of *coarse* volcanic dust from volcanoes in Iceland which absorbed the long wave-length earth radiation better than the short solar radiation thus producing the greenhouse effect. Expressions are given which enable the rise in temperature to be expected under given conditions. The abnormally cold winter which was apparently world-wide is attributed to the presence of *fine* volcanic dust in the stratosphere from a volcano in Japan which depleted passing radiation by scattering and not by absorption. A. E. M. G.

119. Thermal Radiation and Absorption in the Upper Atmosphere. G. H. Godfrey and W. L. Price. *Roy. Soc., Proc.* 163*A*. *pp.* 228–249, *Nov.* 19, 1937.—The conditions for radiative equilibrium in the atmosphere above the 100 km. level are examined, taking into consideration the absorbing properties of O_3, H_2O and O_2. Graphs are provided giving the equilibrium temperatures for different concentrations of these substances extending over a wide range. The investigations are primarily for the latitude of Sydney but changes of latitude within certain limits do not materially affect the results. Midwinter conditions are assumed, but here again seasonal changes are found to have negligible effects (except as they may affect the relative concentrations of the absorbing substances). It is found that the existence of high temperatures, of the order 1000° C. or more, in the F-region of the ionosphere, is a necessary consequence of the presence of appreciable O_2 at these levels. Seasonal variations of these temperatures must be small, however. The approach to equilibrium conditions in the time available is considered, and curves are given from which may be obtained the rates of cooling at night and of heating by day. An investigation is made of the discrepancy between the results of Penndorf and of Gowan on the rate of heating due to ozone at 50 km. The result obtained supports Gowan's estimates. A case is analysed assuming the distributions of temperature and pressure suggested by Martyn and Pulley and an estimate is made of the effect of the convection which seems to be indicated by these authors' results. [See Abstracts 2094 and 5479 (1936).] AUTHORS.

120. Theory of Monsoons. Part II. Vertical Distribution of Velocities. W. W. Shoulejkin. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 16. 6. *pp.* 305–309, 1937. *In English.*—In a previous paper [see Abstract 3973 (1937)] the vertical structure of air currents was given schematically. The present paper deals with the actual distribution. Previously the tangential component of air currents played no part as the shape of the sea considered was circular. To make the results applicable to a sea of any given shape, both radial and tangential components are now investigated, and equations of motion given. From these solutions are obtained for the radial and tangential velocities in terms of the height. Curves are drawn showing the variations in both. The author then proceeds to discuss the relative depths of the two currents (inflowing and outflowing) in the monsoon stratum, and shows that these are in the ratio of about 4 : 1. This necessitates a modification of the velocity distribution curve which is then in agreement with the corresponding modification required in the temperature distribution curve. A. E. M. G.

121. Intensity Distribution Variation in the Auroral Spectrum. L. Vegard and E. Tønsberg. *Geofysiske Publ.* 11. 16. [36. *pp.*], 1937. *In English.*—The problems investigated comprise variation of intensity distribution (a) amongst vibrational bands of the same system, (b) along the branch of a band (a question intimately connected with the determination of the temperature of the auroral region), (c) among the various N_2 band groups, (d) between the red triplet and green single line of O_2, (e) of the intensity of the green O_2 line compared with that of the N_2 bands. The main results obtained are summarised so as to show how the items mentioned above are affected by altitude and type of aurora, and by exposure of the auroræ to sunlight. A. H.

122. Height Measurements of Selected Auroral Forms. L. Harang. *Geofysiske Publ.* 12. 1. [31 *pp.*], 1937. *In English.*—The paper deals with the results of observations carried out between 1930 and 1936 at Tromsø. After describing the methods of photography and reduction of photographs the author first discusses cases of auroræ in the dark atmosphere. Thereafter he proceeds to consider sunlit auroræ in various forms. Feb., 1936, was extremely rich in those forms, seven out of the total of 13 cases investigated in the paper occurring in that month, all sunlit. The discussions are fully illustrated with line diagrams and photographic reproductions. The paper concludes with a discussion of the connection between the heights of auroræ in passing from the sunlit to the dark atmosphere, and the temperature of the atmosphere at these heights. A. E. M. G.

123. Survey of Facts and Theories of the Auroræ. E. W. Hewson. *Rev. Modern Physics,* 9. *pp.* 403–431, *Oct.,* 1937.—In the introduction the author reviews the types and the geographical distribution of auroræ and the connection between auroral activity and magnetic storms. The determinations of the heights of auroræ by the help of photographic methods, and the measurements of auroral intensity are then discussed. Differences in height and colour between ordinary and sunlit auroræ are pointed out. Thereafter the author proceeds to discuss the important results obtained in connection with the investigations of the auroral spectrum. Theories on the probable origin of auroræ are grouped under two heads—(1) Corpuscular theories wherein a mathematical treatment of the subject and a comparison of theory with experiment are set forth; (2) Secondary corpuscle theory in which the origin is attributed to u.v. light. Diagrams and photographic reproductions illustrate the paper. A. E. M. G.

124. Photometry of the Purple Light. Part II. P. Gruner. *Gerlands Beitr. z. Geophys.* 51. 2–3. *pp.* 174–194, 1937.—A further detailed discussion of results previously obtained and a few new ones, with some account of the connection between them and the weather. [For Part I see Abstract 3980 (1937).] C. A. S.

125. Observations of a Searchlight Beam to an Altitude of 28 Km. E. O. Hulburt. *J.O.S.A.* 27. *pp.* 377–382, *Nov.,* 1937.—The beam of a high intensity searchlight directed over an observing station 18·4 km. distant at angles of 30° and 45° to the horizontal was visible to a vertical altitude of about 20 km. and was photographed to 28 km. on clear nights. The intensity of the beam measured from the photographs was of the same order of magnitude as that calculated from the Rayleigh theory of molecular scattering using standard tables of stratospheric densities. At 5 km. the observed intensity was greater than the theoretical intensity by a factor of about 7, the factor decreasing to about unity above 10 km., as would be accounted for by a small number of haze particles at 5 km. which decreased to an imperceptible amount above 10 km. AUTHOR.

***126. Shielded Storage Precipitation Gauges. J. C. Alter.** *Monthly Weather Rev.* 65. *pp.* 262–265, *July,* 1937.—The amount of precipitation caught by a gauge in strong winds and with no shielding is generally less than the correct value, the deficit, particularly in the case of snow, increasing with the wind velocity. The need for a dependable seasonable snow gauge has resulted in a number of different methods of shielding being devised. Salt and oil placed in the gauge have proved effective in retaining the total precipitation caught over a period. A description of the method of shielding 20 gauges placed 7 miles west of Salt Lake City on a wind-swept plain is given: also of other gauges mounted at other stations at elevations over 8000 ft. The results obtained from these and their relative efficiencies are given in tabular form. A. E. M. G.

See also Abstracts 22, 53, 373, 374 and

79B. Effect of Yaw on Vane Anemometers. R. H. Heald and P. S. Ballif.

SEISMOLOGY.

***127. Experimental "Seismeter." F. A. Perret.** *Am. J. Sci.* 34. *pp.* 469–474, *Dec.*, 1937.—A simple, robust and inexpensive instrument has been devised for recording the accumulated magnitude of ground movements in regions of considerable seismic activity. The device consists essentially of three ordinary pedometers mounted in three mutually perpendicular planes. Some results obtained in the vicinity of Montserrat (British West Indies) are presented, and a suggestion for an improved seismeter is given. AUTHOR.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

***128. Air Potentials. K. L. Sherman.** *Terr. Mag.* 42. *pp.* 285–288, *Sept.*, 1937.—Further report on leak-free and null methods of making electrostatic measurements. The circuit, shown schematically, is more complex than the conventional one but the total time for a set of observations is less with this method. Details are given of the apparatus employed, its preparation for use, and method of operation. [See also Abstract 1145 (1930).] R. S. R.

129. Ionisation Produced by the Evaporation of Water. E. Medi. *Accad. Lincei, Atti*, 26. *pp.* 159–165, *Sept.*, 1937.—Drops of water were made to fall into a cylinder placed within an enclosure heated by a small electric furnace. The air containing ions due to the evaporation of the water from the drops was drawn off by means of an electric aspirator through a condenser consisting of two co-axial cylinders. The internal cylinder was connected to an electrometer of Dolezalek type and thus the charge in the air could be measured, the capacity of the condenser being known. In an experiment in which the temperature of the furnace was about 470° C it was found that due to the rapid evaporation of the water there was an excess of positive charge, as in Volta's experiments, and this charge was 3×10^{-10} coulomb for each drop, and hence as the drops had a volume of 1/18 cm^3., 54×10^{-10} coulomb/gm. If it is admitted that this same behaviour occurs in the slow evaporation from the surface of the oceans there is a sufficient explanation of the positive charge present in the atmosphere solely through evaporation. J. J. S.

130. Dissociation, Recombination and Attachment Processes in the Upper Atmosphere. Part I. H. S. W. Massey. *Roy. Soc., Proc.* 163*A*. *pp.* 542–553, *Dec.* 22, 1937.—The probabilities of various collision reactions which occur in the E- and F-regions of the ionosphere are considered in general terms. In particular the relative importance of recombination and attachment in effecting electron removal is discussed. As processes in which electrons are detached from negative ions can be expected to go on at a considerable rate (much faster than recombination) and as attachment must also occur very rapidly, the most reasonable representation of the phenomena is to consider the negative ions and electrons as in a dynamical equilibrium adjusting itself rapidly to loss of either by recombination. In this way the usual recombination theory may be retained, even though attachment occurs much more rapidly. A consequence of the theory is that the number of negative ions should considerably exceed the number of electrons in the E-region as required by the "dynamo" theory of magnetic variations. The low rate of recombination in the F-region, requiring the density of positive ions to be not much greater than that of the electrons, makes it necessary to suppose that, at these levels, the atmospheric gases present are inert towards electron attachment. AUTHOR.

131. Lightning Discharges in the Upper Atmosphere. D. Malan. *Comptes Rendus*, 205. *pp.* 812–813, *Nov.* 3, 1937.—A particular type of discharge consisting of a long faint band of reddish light stretching above the clouds observed in South Africa in Jan., 1937, is described. The author considers that this phenomenon may be regarded as a disruptive discharge between the cloud and the ionosphere. Owing to the faintness of illumination the discharge could not be photographed. A. E. M. G.

132. Progressive Lightning. Part IV. Discharge Mechanism. B. F. J. Schonland. *Roy. Soc., Proc.* 164*A*. *pp.* 132–150, *Jan.* 7, 1938.—Oscillographic observations indicate that all processes in the discharge to ground observed in South Africa involve a cloud kathode and an earth anode. The first lightning stroke appears to involve: (*a*) The development of a pilot streamer, a negative streamer proceeding from the cloud into virgin air. (*b*) The periodical catching up of this pilot streamer by a much faster step streamer, a negative streamer advancing along an ionised path. (*c*) The distribution by this leader process of the greater portion of the cloud charge tapped by it upon a branched leader channel in the air below the cloud. (*d*) The passage of this charge to ground in the return stroke, a positive streamer travelling along an ionised and oppositely charged path. The second and subsequent strokes involve: (*a*) A fast dart streamer, a negative streamer advancing along an ionised path. (*b*) A return stroke streamer similar to (*d*). The mechanisms of the three types of streamer are investigated. Satisfactory explanations of their behaviour can be derived. Discussions are given of the currents in the various streamer processes, of the luminosity associated with their movement and of the effect of space-charge on leader development. Evidence is given which indicates that the occurrence of separate strokes in the discharge is due to the presence in the cloud of separate charge-generating centres. [For Part III see Abstract 4447 (1937).] AUTHOR.

133. Electric Charges on Single Raindrops and Snowflakes. J. A. Chalmers and F. Pasquill. *Phys. Soc., Proc.* 50. *pp.* 1–16, *Jan.* 1, 1938.—An account is given of 16 months' observations on the charges of individual raindrops and snowflakes. The results show an excess of positively charged drops and of total positive charge, except for storm rain. The average charge per drop is greater in the case of negative than of positive raindrops, but the reverse holds for snowflakes. Observations were also made of the sequences of drops of one sign, of the relative proportions of drops of the two signs in different parts of a single rainfall and of the distribution in magnitude of the charges. A brief discussion is given of the problems of the origin of the charges on rain. AUTHORS.

See also Abstracts 123, 371.

RADIOACTIVITY.

134. Statistical Character of Radioactive Decay Law and Collision Frequency Distribution in Ionisation Chamber. E. Schüttlöffel. *Zeits. f. Physik*, 107. 7–8. *pp.* 425–440, 1937.—An investigation has been carried out to test whether the fluctuations of radioactive decay agree with the fluctuations which have been calculated from probability considerations, that is, whether the laws of decay have a statistical character or not. For the measurements a spherical ionisation chamber was used, so that the directions in which the α-particles were emitted have a minimum significance. Curves obtained show a satisfactory agreement between theory and experiment. The dispersion coefficient can be calculated; a value of 0·913 is found. The mean fluctuations found from the measurements agree with the calculated values, while the variations lie within the limits of experimental error. A second curve shows complete agreement between the measured values and those calculated from the Langevin formula. Curves giving the distributions of the numbers of collisions in chambers of Fe and also of Cu, which have been filled with air for two years, enable conclusions to be drawn as to the presence of certain active substances. G. O. B.

135. Optimum Counting-Time for Measuring the Intensity of a Radioactive Source. J. Tandberg. *Phys. Soc., Proc.* 50. *pp.* 87–89, *Jan.* 1, 1938.—When the intensity of a radioactive source is measured by means of a Geiger-Müller counter, maximum accuracy is obtained by continuing the counting for a finite time which depends on the average life of the radioactive source and on the intensity of the background interference. AUTHOR.

136. Absorption of β-Rays in Rubidium. Z. Ollano. *N. Cimento*, 14. *pp.* 314–321, *July*, 1937.—An arrangement of counters in coincidence is described and applied to the analysis by absorption of particles of moderate energy. A study of the β-rays emitted by Rb leads to the identification of a group with an absorption coefficient in Al of 422 cm.^{-1}, and indicates the presence of another inhomogeneous group with absorption coefficient greater than 1050 cm.^{-1}. Within the limits of experimental error, there is no evidence of β-radiation of greater energy. With a modified apparatus results are obtained which suggest the emission of X-rays as the products of the disintegration of Rb(Sr 87). C. J. B. C.

137. Potassium-Argon Transformation. A. Bramley. *Science*, 86. *pp.* 424–425, *Nov.* 5, 1937.—Following on some calculations of Møller and v. Weizsäcker [see Abstract 4451 (1937)] as to the possibility of a nucleus of atomic number Z disintegrating into one of atomic number Z − 1 by absorption of a K electron of the first atom into the nucleus of the second atom, the author discusses the probability of such a transition, namely $K^{40}_{19} \rightarrow A^{40}_{18}$, on the basis of the abundance of A^{40} and Ca^{40} on the earth's surface, and also the mechanism of the disintegration. G. O. B.

138. Ionising Power of Li-Particles. F. Kirchner, H. Neuert, and O. Laaff. *Ann. d. Physik*, 30. 6. *pp.* 527–533, *Nov.*, 1937.—The Li^7 particles occurring in the transformation process :—$Be^9 + D^2 \rightarrow Li^7 + He^4 + \Delta m$, have been studied as regards their ionising power, by means of an ionisation chamber, amplifier and kathode-ray tube using photographic recording. The range of the particles is between 12 and 12·5 mm. The experiments furnish data regarding the ionising power for about

8 mm. of this track measured backwards from the end of this range. At first the ionising power increases very rapidly—more so than in the case of α-particles; between about 2–8 mm. it is approximately constant and at about 8 mm. it again increases. This second increase appears to be due to triply charged particles; in the other parts of the track the particles are practically certainly singly charged. The question of the Be^8 particle is also discussed. G. G.

139. Radioactive Isotopes of Bromine. A. H. Snell. *Phys. Rev.* 52. *pp.* 1007–1022, *Nov.* 15, 1937.—Cross-checking of nuclear reactions induced by bombarding As, Se, Br, Kr, and Rb with neutrons, deuterons, and electrically accelerated α-particles indicates that the active ^{80}Br exists in two isomeric forms with decay periods 18 min. and 4·5 hrs. Two successive β-transitions occur in the active ^{83}Se and ^{83}Br, and the reaction $^{82}Se \rightarrow {}^{82}Br$ is a new type of transmutation in which the emission of two neutrons apparently follows deuteron capture. Results and identifications are: ^{78}As(65 ± 3 min.), ^{83}Se(17 ± 5 min.), $^{79 \text{ or } 81}Se$(57 ± 1 min.), ^{78}Br(6·4 ± 0·1 min., positron emitter), ^{80}Br(18·5 ± 0·5 min., and 4·54 ± 0·10 hr.), ^{82}Br(33·9 ± 0·3 hr.), ^{83}Br(2·54 ± 0·10 hr.), Kr(74 ± 2 min., 4·5 ± 0·1 hr., 18 ± 2 hrs.), $^{86 \text{ and } 88}Rb$(18 ± 2 min., 18 ± 1 days). All these activities except ^{78}Br and possibly the very weak 18 hr. Kr emit negative electrons. Maximum energies of the β-rays of the Br isotopes were found by absorption measurements. ^{78}Br, ^{80}Br(18 min.), and ^{82}Br emit γ-rays. [See Abstract 3396 (1936).] N. M. B.

140. Disintegration of Be and Masses of Be Isotopes. J. H. Williams, R. O. Haxby and W. G. Shepherd. *Phys. Rev.* 52. *pp.* 1031–1034, *Nov.* 15, 1937.—The following disintegrations have been studied up to bombarding energies of 250 kV, (1) $Be^9 + H^1 \rightarrow \begin{pmatrix} Be^8 + H^2 \\ Li^6 + He^4 \end{pmatrix}$, (2) $Be^9 + H^2 \rightarrow Li^7 + He^4 + Q_2$, (3) $Be^9 + H^2 \rightarrow Be^8 + H^3 + Q_3$, (4) $Be^9 + H^2 \rightarrow Be^{10} + H^1 + Q_4$. Efficiency curves for the four reactions are smooth and regular. Absolute yields from a thick target are given. Range measurements of the disintegration products determine the values of Q_2, Q_3, Q_4 as 6·95, 4·32 and 4·44 eMV respectively and the masses of Be^8, Be^9, Be^{10} as 8·0081, 9·0150 and 10·0168. [See also Abstracts 1873 and 4246 (1937).] AUTHORS.

141. Neutrons from the Disintegration of Nitrogen by Deuterons. W. E. Stephens, K. Djanab and T. W. Bonner. *Phys. Rev.* 52. *pp.* 1079–1082, *Dec.* 1, 1937.—The energy distribution of the neutrons resulting from the disintegration of N by 0·93 eMV deuterons has been investigated in a high pressure cloud chamber. Three groups of recoil protons were found with maximum energies of 5·7, 2·7 and 1·9 eMV and with relative intensities of 2 : 1 : 3. The 2·7 eMV group is attributed to deuterium contamination on the target. The other two groups are from the reaction ${}_7N^{14} + {}_1H^2 = {}_8O^{15} + {}_0n^1 + Q_1$ where $Q_{10} = 5 \cdot 1 \pm 0 \cdot 2$ eMV and $Q_{11} = 1 \cdot 1 \pm 0 \cdot 2$ eMV. AUTHORS.

142. Longest Range Proton Group in the Disintegration of Boron by α-Particles. H. Maier-Leibnitz and W. Maurer. *Zeits. f. Physik,* 107. 7–8. *pp.* 509–512, 1937.—The range of the protons emitted by B bombarded by α-particles from a Po source of strength 20 mC, is examined with an ionisation chamber. The number-range curve obtained was a cubic and gave the maximum range of the emitted protons as 91 ± 2 cm. This corresponds to an energy change of 3·7 eMV in agreement with mass-defect calculations. The existence of a high energy group of range about 160 cm., reported by Brubaker and Pollard, is not confirmed. F. C. C.

143. Transmutation of B^{10} into C^{13}. W. Bothe and H. Maier-Leibnitz. *Zeits. f. Physik*, 107. 7–8. *pp.* 513–522, 1937.—When bombarding B with α-particles, a large number of proton groups are found, the fastest observed protons having a range of about 80 cm. for Po α-rays. If these protons are assumed to be emitted when the remaining C^{13} is left in its ground state values are obtained for the nuclear masses which disagree with those obtained by other means. Recently a very small number of protons with 91-cm. range were found. If these are assumed to belong to the ground state then the emission of an 80-cm. proton must leave the nucleus in an excited state. Experiments with a coincidence counter were therefore made to find whether simultaneously with the 80-cm. protons γ-rays or electrons are found. These gave a negative result. Another set of experiments was made to see whether any γ-rays are given out after the bombardment. This would be expected for a metastable state. The intensity to be expected depends on whether it be assumed that from higher excited states the nucleus also passes through this metastable state or whether in the majority of cases it would always drop directly to the ground state, unless an 80-cm. proton had been emitted. The experiments are sensitive enough to rule out the first alternative, but not the second. If this were also excluded, it would have to be assumed that the excited state is stable, and that it represents therefore an isomer of C^{13}. R. P.

144. Transmutation Function for Deuterons. P. L. Kapur. *Roy. Soc., Proc.* 163*A*. *pp.* 553–568, *Dec.* 22, 1937.—A generalisation of the method of geometrical optics, commonly known as the Wentzel-Kramers-Brillouin method, is applied to the case of transmutation by deuterons. The treatment of Oppenheimer and Phillips [see Abstract 4045 (1935)], based on the approximation of a three-body problem, is improved in so far as the wave equation is not assumed to be separable. The generalisation gives, in general, an upper limit to the probability of the process, but in the present case it is shown that it gives the correct value. The results of the calculations are given in a table and two diagrams. Formulæ are also obtained which take into account the finite radius of the nucleus. The results are compared with experiments on copper and are found to be in fair agreement, when the binding energy of the deuteron is taken to be 2·25 eMV [see Abstract 335 (1938)]. AUTHOR.

145. Radioactivity of Nickel, Copper and Zinc. F. A. Heyn. *Physica*, 4. *pp.* 1224–1228, *Dec.*, 1937. *In English.*—The radioactivity of Ni, Cu and Zn induced by neutrons of different energies is investigated. Some new reactions are reported. AUTHOR.

***146. Reflection of α-Particles of RaC′ by Heavy Atomic Nuclei. K. Krammer.** *Akad. Wiss. Wien, Ber.* 146. 2*a*. 1–2. *pp.* 71–88, 1937.—The reflections of RaC′ α-particles from the elements Ag, Sn, Sb and Te, are measured, together with the range of the reflected particles. An ionisation method of measurement is used, full descriptions of the ionisation chamber, electrometer valve, amplifier and kathode-ray oscillograph being given. The observed differential absorption curves agreed with the Rutherford-Darwin scattering formula for heavy elements and the extents of the coulomb fields in the nuclear regions were found to be :—Ag $1\cdot84 \times 10^{-12}$ cm., Sn $1\cdot97 \times 10^{-12}$ cm., Sb $2\cdot00 \times 10^{-12}$ cm., Te $2\cdot04 \times 10^{-12}$cm., No anomalous scattering was found in the elements observed. J. E. R.

147. Number of α-Particles Emitted by Active Deposit of Thorium. A. Ricoux. *J. de Physique et le Radium*, 8. *pp.* 388–390, *Oct.*, 1937.—The method is described in detail with all necessary corrections. Thus determined the ionisation current produced by the total absorption of the α-particles in the solid angle 2π from Ra is 2·156 e.s.u./mg., whence it is deduced that 1 millicurie of active deposit of Th is equivalent to 0·91 mg. Ra. C. A. S.

148. Air Equivalent of γ-Radiation. R. Schulze and W. Minder. *Helv. Phys. Acta*, 10. 5. *pp.* 403–421, 1937. *In German.*—The variation in the apparent intensity of a γ-ray source, with the distance of the source from the detector, is examined with a paper-walled ionisation chamber. By carrying out the experiments in rooms of different shapes and sizes it is shown that the scattered radiation which passes through the thin walls of the chamber constitutes an indefinite correction up to about 10% when the scattering objects are less than 4 m. from the chamber. The insertion of screens of 4 m. equivalent air thickness allows the construction of a dosimeter for use in small rooms. F. C. C.

149. Relative Efficiency of Tube Counters of Different Materials Under the Action of Hard γ-Rays. K. Buchmann. *Phys. Zeits.* 38. *pp.* 817–824, *Nov.* 1, 1937.—The efficiency of counters of either Pb, brass or Al when subjected to γ-rays from ThC″, is examined. For the complete radiation the yield was in the ratio 100 : 78 : 68, in agreement with the theory of v. Droste. Improvements may be effected by changing the linear dimensions of the counters and an optimum yield occurs for Pb at a thickness of 0·65 mm. F. C. C.

150. Absorption and Scattering of Hard γ-Rays. W. Gentner. *Phys. Zeits.* 38. *pp.* 836–853, *Nov.* 1, 1937.—Recent theories of the processes involved in the interaction of hard electromagnetic radiations with matter are considered with a view to comparison with experimental results. For any element and wave-length it is possible to calculate σ the scattering absorption coefficient from the Klein-Nishina formula, κ, the nuclear (pair formation) coefficient from the formula of Bethe and Heitler, and τ the photoelectric coefficient from the work of Hulme and others. The sum of these gives the total absorption coefficient. The experimental methods of a number of workers are then reviewed and the results compared with those calculated from the formulae. In particular curves are given showing the variation of μ_e with atomic number for $h\nu = 2\cdot65$ eMV and the variation of the absorption coefficients of lead with wave-length over a range from 1 to 25 X.U. Scattering of the radiations is considered in a similar way. A comprehensive Bibliography is included. J. E. R.

***151. Simple Quartz-Fibre Electrometer. C. C. Lauritsen and T. Lauritsen.** *Rev. Sci. Instruments*, 8. *pp.* 438–439, *Nov.*, 1937.—The instrument, described in detail, somewhat resembles the gold-leaf electroscope but is much smaller, and the gold leaf is replaced by a gold plated quartz fibre. It is specially suited for the study of weak radioactive sources, as with a light fibre a sensitivity as high as 700,000 ions per scale division is attainable. C. A. S.

***152. Cloud Chamber for Nuclear Disintegration Studies. H. R. Crane.** *Rev. Sci. Instruments*, 8. *pp.* 440–444, *Nov.*, 1937.—Construction of an entirely automatic cloud chamber particularly adapted to the study of the high energy electrons produced in artificial disintegration experiments is described. Air core coils which are capable of producing magnetic field strengths up to 4000 gauss at the time of expansion are used. An incandescent light source, using three 1000-W projection bulbs furnishes sufficient light for ½ sec. camera exposure. Author.

See also Abstracts 11, 299, 333, 334, 335, 336, 339, 362, 363.

RADIATION.

ABSORPTION.

See Abstracts 191, 233.

COLORIMETRY.

***153. Subjective Study of Colour Mixtures. V. H. Pavlović.** *Comptes Rendus*, 205. *pp*. 791–792, *Nov*. 3, 1937.—A method is described for the stroboscopic observation of an improved Newton's disc [see Abstract 3520 (1937)]. The disc is illuminated by sparks or electrodeless tubes activated by a Tesla coil the current being interrupted by a mercury break. H. G. C.

EMISSION.

154. Cloud Chamber Investigations of Cosmic-Ray Interactions With Matter. G. L. Locher. *Frank. Inst., J.* 224. *pp*. 555–582, *Nov*., 1937.—Several hundred photographs were taken with a cloud chamber, controlled by counters placed in a horizontal line, sometimes below and sometimes above the chamber, with sheets of various absorbing materials over the whole assembly. No magnet was used. A few of the photographs showed tracks attributed to nuclei. The specific ionisation of 9 shower electrons was determined, an average value of 68·7 ion pairs per cm. at atmospheric pressure being obtained. Most of the nuclear tracks observed are attributed to cosmic-ray interactions with matter. These are discussed at length and suggestions are made regarding their origin. D. H. F.

155. Production of Cosmic-Ray Showers at Great Depths. W. H. Pickering. *Phys. Rev*. 52. *pp*. 1131–1134, *Dec*. 1, 1937.—Experiments are described which prove the existence of cosmic-ray showers consisting of at least three particles, at depths down to 30 m. of water below sea level. The experiments also show that the number of showers decreases in much the same way with depth as the number of vertical coincidences. Even in the first few meters of water there is no marked falling off in the relative number of showers. The effect of lead on the showers at great depths is also discussed. Author.

156. Ionising Radiations Emitted by Metals. G. Reboul and J. Reboul. *Comptes Rendus*, 205. *pp*. 789–791, *Nov*. 3, 1937.—The ionisation produced in vessels of various metals (Sn, Pb, Fe, Zn, Al, Cu and Ni) arranged so that they can be surrounded by various thicknesses of Pb, showed that they emitted a secondary radiation in great part due to hard cosmic radiation from outside. Further experiments with a condenser of the metal to be examined, with armatures that can be placed at varying distances, the whole of which could be placed within a vessel of the same metal, showed the ionisation to be due partly to radiation from outside, and partly to slightly penetrating radiation from the metal itself, the coefficient of absorption of which in air was for the above metals, respectively, 0·45, 0·30, 0·11, 0·09, 0·10, 0·13 and 0·16. C. A. S.

See also Abstract 333.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

157. Fluorescence of Octohydrofluorocyclene, $C_{48}H_{36}$. S. Pieńkowski. *Acad. Polonaise Sci. et Lettres, Bull.* 6–8*A*. *pp.* 269–277, *June–Oct.*, 1937.—Under excitation by Hg vapour light, this substance shows four bands in the violet, blue and green. Solution in xylene, chloroform or acetic acid produces much the same bands but in CS_2 there is a considerable shift. The solid state gives quite a different photometer curve, the violet band being much suppressed and the green band enhanced. The vapour gives the violet and blue bands only. The product of thermal decomposition shows fluorescent bands corresponding to decacyclene and to some other unknown hydrocarbon. J. E.

158. Fluorescence and Absorption of Biacenaphthylidene, $C_{24}H_{16}$. B. Twarowska. *Acad. Polonaise Sci. et Lettres, Bull.* 6–8*A*. *pp.* 278–284, *June–Oct.*, 1937. *In French.*—There are two sets of absorption bands, those at 4100 and 3250 Å and those corresponding to naphthalene absorption. Only the former are responsible for fluorescent excitation. From air temperature to liquid-air temperature the fluorescent bands are the same for solution as for solid and gas states. At 300° C. a new substance is formed—red biacene which gives a red fluorescence. This substance dissolved in ortho-xylene gives the same fluorescence as ordinary biacene. It is therefore supposed to be a dimorphic form. In the gas state, however, its absorption shows two regions, one consisting of broad bands and corresponding to ordinary biacene, and another set consisting of sharp u.v. bands and corresponding to acenaphthene. J. E.

159. Wave-Length Dependence of Fluorescence of Biacenaphthylidene Solutions. Z. Lewkowicz. *Acad. Polonaise Sci. et Lettres, Bull.* 6–8*A*. *pp.* 285–294, *June–Oct.*, 1937. *In German.*—As found by previous workers, the fluorescence output increases as the exciting light approaches the wave-length of the fluorescent band maximum from the long-wave side, falling suddenly to zero when this is passed. The shapes of the curves, however, do not agree with those found by Wawilow and others for fluorescein [see Abstract 2275 (1927).] J. E.

160. Influence of Admixed Gases and of a Magnetic Field on the Degree of Polarisation of the Fluorescence of Iodine Vapour. S. Mrozowski. *Acad. Polonaise Sci. et Lettres, Bull.* 6–8*A*. *pp.* 295–311, *June–Oct.*, 1937. *In German.*—Results and details are communicated of measurements carried out to provide a comprehensive quantitative basis for the theory developed by the author in previous publications [see Abstracts 1181 and 2442 (1934), 2042 (1937)] of the influence of collisions on the degree of polarisation of molecular fluorescence. I_2 vapour is chosen as most suitable for the measurements which fall essentially into 3 series; (*a*) measurements of the influence of admixed H_2 and He at various pressures on the polarisation of u.v. I_2 fluorescence, (*b*) similar measurements of visible I_2 fluorescence using admixed H_2, He, Ne, A and N_2, (*c*) measurements of the effect of a magnetic field on the polarisation of visible fluorescence which provide data for the reduction of series (*d*) measurements to a constant life period in the excited state. The experimental results are clearly presented in graphical form and in discussion are shown to be in conformity with the author's theory that the degree of polarisation is a decreasing function of $l^2 \cdot N/Jo$, where l is the average change of rotation of the molecule in a collision, Jo is the rotation of the molecule immediately after excitation and N is the mean number of depolarising collisions during the life period in the excited state. It is deduced that, in contrast to the case of the depolarisation of atomic resonant radiation, the main factor in the depolarisation of molecular fluorescence is the mass and not the internal electronic structure of the colliding particle. J. E. K.

161. Quenching of Fluorescence of Solids by Adsorbed Gases. V. Hachkovski and A. Terenin. *Acta Physicochimica,* 7. 4. *pp.* 521–550, 1937. *In English.*—The visible fluorescence of Al_2O_3 and ZnO is quenched when the vapours of I_2, Cl_2, H_2O and O_2 at low pressures are adsorbed on them. The effect is more pronounced in the blue part of the continuous fluorescence spectrum and diminishes gradually towards the red end. Other gases, as H_2,CO, Hg-vapour, produce no effect; the vapours of CH_3OH, C_2H_5OH, CH_3I, CH_3CN and NH_3 on the contrary, enhance the fluorescence to some extent, which is attributed to the removal by them of adsorbed quenching impurities. A temperature increase up to 100° C. reduces the quenching. The efficiency of the quenching by different gases is intimately related with their ability to capture free slow electrons with the formation of negative ions. The quenching must therefore be attributed to a similar process occurring with adsorbed molecules and photoelectrons liberated at the surface of the fluorescing solid. The quenching is furthermore used to detect free electronegative atoms and radicals produced by photodissociation of the molecules CH_3I, C_2H_5OH, $C_6H_5NH_2$ and C_6H_6 in the adsorbed state. AUTHORS.

162. Determination of Real Fluorescence Polarisation of Solutions at High Concentrations. S. I. Wawilow. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 16. 5. *pp.* 255–258, 1937. *In German.*—A method is suggested for overcoming the effects of secondary fluorescence and absorption in measurements of depolarisation of fluorescence of solutions at high concentrations. [See following Abstract.] C. B. A.

163. Fluorescence Depolarisation of Solutions at High Concentrations. S. I. Wawilow, P. G. Gluchow and I. A. Khwostkow. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 16. 5. *pp.* 259–261, 1937. *In German.*—The method described for measurements of fluorescence at high concentrations [see preceding Abstract] is used to investigate fluorescence depolarisation in strong solutions of fluorescein in glycerin, and it is shown that all the assumptions on which it is based are justifiable. C. B. A.

164. Coloration and Luminescence of Fluorite. E. W. Kellermann. *Akad. Wiss Wien, Ber.* 146. 2*a*. 1–2. *pp.* 115–144, 1937.—The blue coloration produced in fluorites from different localities by u.v. irradiation after radium irradiation has been studied through the measurement of the absorption spectrum at low temperatures. This coloration is linked with a reduction of the violet absorption maximum and an increase of the absorption in the yellow. The effect of the u.v. radiation is reversed by bringing the sample up to room-temperature or by infra-red radiation.

From the result it is concluded that there exists an excited state of the crystal. By making heavy metal additions to rare-earth activated synthetic fluorites, it is concluded that the effect of the addition is to extend the red Sm band towards the shorter wave-lengths. The colouring of the synthetic fluorite is considered and the structure of the colour centre discussed.

J. E.

165. Luminescence of Fluorites and other Minerals. Part III. H. Haberlandt. *Akad. Wiss Wien, Ber.* 146. 2*a*. 9–10, *pp*. 1–10, 1937.—A continuation of previous work [see Abstract 2142 (1936)]. The results of observations on 200 fluorites are given in respect to their low-temperature fluorescence. From this survey it appears that an overwhelming number of fluorites, showing a green low-temperature fluorescence are associated with acidic volcanic rocks and contain Yb. In agreement with Steinmetz [see Abstract 615 (1936)] a close connection is found between colour and thermoluminescence while no definite connection can be established between mineral genesis and thermoluminescence. A thermoluminescent band in the blue green is associated with the presence of Mn. The thermoluminscent spectra of several Ca and Si containing minerals was studied and associated with rare earths and uranium. J. E.

166. Electric and Luminescent Properties of Willemite under Electron Bombardment. W. B. Nottingham. *J. of Applied Physics*, 8. *pp*. 762–778, *Nov.*, 1937.—An insulated surface uniformly bombarded with electrons in a vacuum attains a potential such that an equal number of electrons leave and enter per sec. This potential was found to be a low negative value for low speed electrons but rose to between 6000 and 7000 V for a tube voltage of 10000 V. The resistance of the sample between two metal electrodes embedded in it was found to be little affected by the bombardment except insofar as the temperature was raised by it. The light output was found to be increased linearly with the electron current up to currents below 2·5 μA but beyond this a saturation effect set in gradually. For constant current the light increased with voltage according to the square of the excess voltage above a dead voltage. With an experimental kathode-ray tube the screen potential increased with the current while the light increased with the square of the bombarding voltage up to 1500 V but above this increased according to a 1·2-power law.

J. E.

167. Luminescence in Liquids under Ultrasonic Treatment. V. L. Levšin and S. N. Rževkin. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 16. 8. *pp*. 399–404, 1937. *In English.*—Ultrasonic vibrations from a piezoelectrically excited quartz plate were transmitted to the liquid. The effects of impurities and of liquid and gaseous luminescence quenchers were observed for a number of liquids; the results indicate that acoustic luminescence is due to the formation, inside the liquid, of cavities filled with water vapour. The large p.d. formed when the liquid is disrupted or when the cavities are annihilated gives rise to electric discharges which excite the water vapour into luminescence. P. V.

168. Recombination in the Afterglow of a Mercury Discharge. F. L. Mohler. *Bureau of Standards, J. of Research*, 19. *pp*. 559–566, *Nov.*, 1937.—A mercury-arc discharge through a 500-cm^3. bulb is extinguished by short-circuiting two anodes on each side of the bulb by a commutator, and probe measurements are made at varying time intervals after the cut-off. Most of the measurements are limited to discharges of 6 and 4 A at a vapour pressure of 270μ. Probe measurements of the number of ions per cm.^{3} in the bulb and of the ion current to the bulb wall give the number of ions recombining in the space and the recombination coefficient $2 \cdot 3 \times 10^{-10}$. The electron temperature decreases with time from 3,000° K. at 10^{-3} sec. to 1,600 at 6×10^{-3} sec. Theoretical considerations indicate that this is probably not a spontaneous two-body recombination. [See also Abstract 4935 (1937).] AUTHOR.

INTERFERENCE, DIFFRACTION AND SCATTERING.

See Abstracts 21, 125, 192, 277, 278.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

169. Photochemical Reactions in the Fluorite Region. Part II. Photochemical Decomposition of Formaldehyde Vapour. R. G. W. Norrish and W. A. Noyes, Jr. *Roy. Soc., Proc.* 163*A*. *pp*. 221–227, *Nov.* 19, 1937.—H·CHO decomposes in the Schumann region to give, as products uncondensed at – 155° C., mainly H_2 and CO, the fraction of the former being slightly lower than in the near ultra-violet. No evidence is found in this work for a primary dissociation into CH_2 radicals and O atoms. Most of the decomposition in these experiments must be caused by the wave-lengths lying below 1600 Å where H.CHO would absorb some of the Lyman bands of H. [For Part I see Abstract 179 (1937).] AUTHORS.

170. Photochemical Polymerisation of Methyl Methacrylate Vapour. H. W. Melville. *Roy. Soc., Proc.* 163*A*. *pp*. 511–542, *Dec.* 22, 1937.—The kinetics of the photochemical polymerisation of methyl methacrylate vapour have been investigated with the following results. Polymerisation occurs nearly quantitatively to a white solid, if the radiation is absorbed by the $COOCH_3$ group in the molecule, *i.e.*, $\lambda >$ 2200 Å. Light of shorter wave-length absorbed by the double bond leads to decomposition of the molecule. After a sufficient time of irradiation, the polymer grows continuously in the dark for several days. This steady growth is proportional to the area of the tube illuminated, to the methacrylate pressure and decreases with increasing temperature. It can be stopped by means of H atoms and I_2 molecules ; it is unaffected by O_2, C_2H_4 and C_2H_2. The polymer is depolymerised to the monomer on heating to 300° C. *in vacuo*. Polymerisation can also be initiated by H atoms, the velocity of which is faster than the normal polymerisation. The rate is independent of methacrylate pressure (above 2 mm.) and H_2 pressure (above 4 mm.), and is also proportional to the square root of the intensity of the light. The mean life of this polymer is *ca.* 10^{-2} sec. It stops growing when two growing polymers collide in the gas. The mechanism of the growth of the methacrylate polymer is discussed and reasons are advanced to explain why one polymer has a long life and the other a short life. The essential difference is believed to be due to a double-bond polymerisation in the former case and a free radical polymerisation in the latter case. AUTHOR.

171. Photochemistry of Alkyl Nitrites. H. W. Thompson and F. S. Dainton. *Faraday Soc., Trans.* 33. *pp*. 1546–1555, *Dec.*, 1937.—Earlier work on the spectra and photochemical decomposition of alkyl nitrites has been extended [see Abstract 4654 (1936)]. The products of photochemical decomposition have now been analysed and a mechanism has been suggested to explain the general course of the reactions. This

mechanism involves the primary fission of the radical NOH and the formation of aldehydes or ketones, and in some cases of unsaturated hydrocarbons. The secondary processes have also been discussed. The vapour pressure curves of the alkyl nitrites studied have been measured.
AUTHORS.

172. Photographic Image Formation and Developer Compositions. E. Schloemann and E. Trabert. *Phot. Indust.* 35. *pp.* 1183–1184, 1186 *and* 1188, *Nov.* 10, *and pp.* 1208–1212, *Nov.* 17, 1937.—Examines the dependence of the building-up of the photographic image on the composition of developers suitable for paper prints. Five developers were used, the characterising of the developer, microphotographic results of the development process, comparison of microphotographs and blackening curves of the development process, and inversion developer being dealt with. R. C. F.

173. Desensitisation by Pressure. Lüppo-Cramer. *Kolloid Zeits.* 81. *pp.* 222–225, *Nov.*, 1937.—In addition to the darkening effect of the shearing pressure on the photographic film, a purely pressure effect is known which manifests itself in a diminution of sensitivity of the unexposed silver halide. It appears as though a mechanical effect of pressure is exerted upon the mature nuclei, which have their degree of dispersion diminished in the same manner as colloidal Ag and the synthetically obtained photohaloids, and in consequence are less active when exposed. H. H. Ho.

174. Sensitisation of Plates by Sodium Salicylate. Tien Kiu. *Comptes Rendus,* 205. *pp.* 794–797, *Nov.* 3, 1937.—Sensitisation of a photographic plate by an aqueous solution of sodium salicylate increases sensitivity in the near u.v. and to a less extent in the visible [see Abstracts 633 (1936) and 628 (1937)]. The investigation is extended to cover a greater range of photographic densities. With low densities and wavelengths > 3341 Å the sensitivity approaches that of the untreated plate. With $\lambda < 3341$ Å the sensitivity curves intersect at a density of $1 \cdot 3$.
H. G. C.

175. Mass and Distribution of Photolytic Silver in Silver Bromide Gelatin Emulsions. W. Meidinger. *Phys. Zeits.* 38. *pp.* 905–919, *Nov.* 15, 1937. *From the Reichsanstalt.*—Gives the results of measurements of the photolytically obtained Ag in emulsions which do not contain nitrite, the experimental methods and the emulsions used being dealt with in previous papers [see Abstract 5311 (1937)].
R. C. F.

176. Effect of Temperature on Production of Latent Image by Hydrogen Peroxide. M. W. Jones and J. M. Blair. *Phot. J.* 77. *p.* 618, *Nov.*, 1937.—Normal characteristic curves were obtained with Eastman 33 plates on treatment with H_2O_2 (0.375%) at 1°, 11°, 21° and 31°C., using log.(immersion times) as abscissæ in place of the usual log.(exposure). An average temperature coefficient of reaction rate of 0·17/°C. was found up to 21°, the rate increasing rapidly above this temperature owing to gelatin breakdown by the H_2O_2. L. V. C.

177. "Kodachrome" Colour Photography. L. Lobel and R. Auvillain. *Soc. Franç. Phot. et Ciné, Bull.* 24. *pp.* 173–182, *Oct.*, 1937.—After briefly describing the construction of the "Kodachrome" colour film, the processing of the exposed film is dealt with in detail. The film, which has three active layers, must be processed in complete darkness, the images of the exposed plate being reversed and the free Ag dissolved out. After reversal the plate is exposed to light again, and then the first development is such that it produces in all layers the blue-green colour for the bottom layer. This development is followed by bleaching which is controlled so that only the top two active layers are affected. A second development is then given which produces the red-magenta colour of the middle layer, this being followed by a bleaching controlled so that it only affects the top layer. Finally, the top layer is developed so that the required yellow colour is produced. Details of the compositions of the various developing and bleaching solutions are fully stated, and the methods of using them outlined. R. C. F.

***178. Precision, All-Purpose Microcamera. L. C. Graton and E. B. Dane, Jr.** *J.O.S.A.* 27. *pp.* 355–376, *Nov.*, 1937.—This microscope, intended primarily for photography with transmitted or reflected light, and particularly at high powers, departs widely from conventional design, especially in massive structure, appropriate materials, and high precision. Its most novel part is the motor-driven fine focussing mechanism which is 100 times slower than on standard instruments; 1 scale division = 0·01 micron or 100 Å. With this precise control of focus and with material for investigation believed superior to any hitherto employed for testing lens quality, results are secured and illustrated which indicate that true depth of focus is substantially less and resolution substantially greater than current theory would permit. Thus, change of focus of 1000 Å can be plainly recognised; and a coloured structure 1070 Å wide is revealed in a photograph at 3175 diameters. It is inquired whether existing microscopical theory may not need review. Since present lenses apparently surpass their theoretical limits, a plea is made for better lenses still. AUTHORS.

***179. High-Vacuum Multiplate Camera. D. A. Richards and R. A. M. Bound.** *Journ. Sci. Instruments*, 14. *pp.* 402–406, *Dec.*, 1937.—The apparatus described was designed to enable several exposures to be made in an electron diffraction camera without letting down the vacuum to remove or replace the photographic plates. The plate changing device can be used equally well with an electron camera or a kathode-ray oscillograph. A feature of the apparatus is that flexible metal bellows are used throughout to avoid the use of ground joints. AUTHORS.

***180. Dimensional Changes in Aerial Photographic Films and Papers. R. Davis and E. J. Stovall.** *Bureau of Standards, J. of Research*, 19. *pp.* 613–637, *Dec.*, 1937.—Results of a study of dimensional changes in aeromapping photographic film and papers under controlled conditions are presented. Both films and papers are subject to a shrinkage from processing. These materials are hygroscopic, consequently their dimensions change with the varying moisture content of the air. Dimensional changes from both processing and moisture content are least in the machine direction, that is, along the roll. Films continue to shrink with time, because of a loss of solvents and plasticiser. This shrinkage is illustrated by accelerated-ageing tests at 120° F. covering a period of 32 days. Two new instruments developed for measuring film shrinkage are described. A reduction of differential shrinkage in the final print or duplicate negative can be had by crossing the machine directions of the negative and printing material during exposure. AUTHORS.

See also Abstract 38.

PHOTOMETRY.

181. Theory of the Luminous Field. A. Blondel. *R.G.E.* 42. *pp.* 579–586, *Nov.* 6, 1937.—The author criticises the theory of the luminous field put forward by A. A. Gersun [see Abstract 4491 (1937).] It is concluded that the theory is based on unjustifiable analogies. This does not apply to the notion of space illumination but it is urged that this notion is of little practical value. W. S. S.

182. Integrating Power of the Eye for Short Flashes of Light. T. E. Gilmer. *J.O.S.A.* 27. *pp.* 386–388, *Nov.*, 1937.—The integrating power of the eye has been tested for short flashes of light, ranging in duration from 10^{-2} to 8×10^{-9} sec. The shorter flashes were produced by passing the image of the straight filament of an electric lamp across a narrow slit, the light having been reflected from a mirror mounted on an air-driven turbine. The longer flashes were produced by means of a sectored disc. In all cases the number of flashes received by the eye was great enough to avoid flicker and the intensity was well above that required to produce the sensation of vision. It was concluded that the response of the eye depends only upon the total amount of light in the beam and is independent of the length of the light flash. The limit of error was 1·5%. AUTHOR.

***183. Counter Tubes for the Visible Spectrum. K. O. Kiepenheuer.** *Zeits. f. Physik*, 107. 3–4. *pp.* 145–152, 1937.—The usual type of photon counter fails when equipped with alkali-metal kathodes because of self-excitation, due, it is suggested, to ion bombardment of the kathode. To overcome this difficulty the author separates the photo-cell from the discharge space of the counter by a thin foil of mica or glass through which the photoelectrons are accelerated by a high potential. By this device it is possible to use a vacuum photo-cell. A counter constructed on this principle showed the expected freedom from self-excitation and gave one discharge per 4000 quanta of blue light. W. S. S.

***184. Use of Blue Filters in the Derivation of Candle-Power Standards. H. Buckley.** *Phil. Mag.* 24. *pp.* 1059–1072, *Dec.*, 1937.—The effect of field-size in the use of certain blue glasses employed to set up the candle-power unit at different colour temperatures is considered. The experimental basis is the fact that in the photometry of high-pressure mercury vapour lamps by the colour-match filter method the result is about 7% higher if a small (2°) field is used than if a large (10°) field is used. This fact is shown to be consistent with the hypothesis that the visibility curve for the large field is identical in shape with that for a small field, but displaced 100 Å in the direction of shorter wave-length. The effect of this shift when the blue glass is used to set up standards of colour temperature 2360° K. from standards of colour temperature 2045° is shown to be about 0·5%. As the standard visibility data were derived for a small visual field (3°) it would appear essential that, in default of evidence to the contrary, the small field should be used in the derivation of the standards of colour temperature 2360°. Alternative methods of setting up the candle-power unit in terms of light of various colour temperatures consistently with the standard visibility data and without the use of blue glasses are considered. AUTHOR.

See also Abstract 124.

POLARISATION.

185. Theories of Optical Rotatory Power. E. U. Condon. *Rev. Modern Physics*, 9. *pp.* 432–457, *Oct.*, 1937.—The earlier classical and quantum theories, and the coupled oscillator model for optical activity are reviewed, and the single electron model of Condon, Altar and Eyring [see Abstract 4950 (1937)] is then described. Kirkwood's theory [see Abstract 3065 (1937)] is outlined. The effects of solvent on rotatory power and circular dichroism are also reviewed. C. B. A.

186. Influence of Neutral Salts on the Optical Rotation of Gelatin. Part VI. D. C. Carpenter and F. E. Lovelace. *Am. Chem. Soc., J.* 59. *pp.* 2213–2216, *Nov.,* 1937.—The rotatory dispersion of gelatin in NaCl solutions at 0·5 and 40° has been investigated. At 40° the dispersion constants bear a linear relationship to salt concentration, $k_{40°} = 44\cdot517 - 2\cdot458\ C_{NaCl}$. The dispersion at 0·5° is the result of two effects, one a linear relation to salt concentration $k_{0\cdot5°} = 99\cdot541 - 2\cdot670\ C_{NaCl}$, and the other a logarithmic function, $C_{NaCl} = \frac{1}{0\cdot634} \log (a/1 - a) - \log (1/K)$ in which log (1/K) equals 4·154. The various dispersion constants so far found for gelatin-sodium halide systems are summarised. [For Part V see Abstract 639 (1937).] AUTHORS.

187. Rotatory Dispersion of Unsaturated Secondary Carbinols and Their Corresponding Chlorides. P. A. Levene and A. Rothen. *J. Chem. Phys.* 5. *pp.* 980–984, *Dec.,* 1937.—In several instances a periodic change in sign of the partial rotation of the chromophoric groups has been observed with the increase in the distance of these groups from the asymmetric C atom. In many unsaturated substances, the ethylenic bond is known to possess a partial rotation of significant value. It was desired to determine whether this partial rotation is subject to a periodic change in sign with the progressive increase in the distance of the double bond from the asymmetric centre. The observations reported here seem to indicate that such a change exists although it is expressed less strikingly than in the case of the carbonyl group previously discussed. AUTHORS.

188. Rotatory Dispersion of Alkyl Azides. P. A. Levene and A. Rothen. *J. Chem. Phys.* 5. *pp.* 985–988, *Dec.,* 1937.—From the viewpoint of chemical behaviour, the $-\ N_3$ group may be regarded as a pseudohalogen. Like iodides, azides possess an absorption band in the near u.v. region. For both practical and theoretical reasons it was important to obtain information on the rotatory properties of the azides as compared with those of the corresponding halides. The correlation of the configurations of primary and secondary azides is discussed in this communication. From the analysis of the rotatory dispersion of the primary azides and halides it became evident that the partial rotations of the azido group and of the halogen atom may be of opposite sign in configurationally related substances, An unexpected observation was made with regard to the members of a homologous series of secondary azides, namely, the rotation in the visible region as well as the partial rotation of the azido group, changes sign on passing from the second member of the series to the third. A tentative explanation of the phenomenon is given. It was found that in all alkyl azides the absorption band at λ2880 is not anisotropic or at best, insignificantly so. AUTHORS.

189. Rotatory Dispersion and Circular Dichroism of *m*-Methyl Cyclohexanone and of Pulegone in their Ketonic Absorption Bands. T. M. Lowry, D. M. Simpson and C. B. Allsopp. *Roy. Soc., Proc.* 163*A*. *pp.* 483–498, *Dec.* 22, 1937.—Molecular extinction coefficients, circular dichroism and rotatory dispersion are recorded for *m*-methyl

*cyclo*hexanone and for pulegone in the region of the u.v. absorption bands. Analysis of the rotatory dispersion on the basis of the observed circular dichroism shows that the partial rotation due to the ketonic absorption band of methyl *cyclo*hexanone is much greater than that of the single asymmetric C atom, and is opposite in sign. A similar result is obtained for pulegone, despite the conjugation of carbonyl and ethylenic double bonds. By comparison with the data for other optically active ketones containing more than one asymmetric C atom, it is concluded that in general the direct contribution of each asymmetric centre is itself small relative to that of the chromophoric group. In the light of Mulliken's analysis of the electronic configurations of aldehydes, the optical activity of the carbonyl group is now attributed to the lone-pair electrons of the O atom, and the theory of "induced dissymmetry" is reinterpreted. A possible function of lone-pairs in producing optical activity in other types of compound is discussed.
AUTHORS.

See also Abstracts 160, 162, 163.

REFLECTION, REFRACTION AND DISPERSION.

190. Computation of Optical Constants. J. B. Nathanson. *J.O.S.A.* 27. *pp.* 393–394, *Nov.*, 1937.—It is shown that the equation recently obtained by Fry gives results identical with those computed by means of Drude's equations whilst the latter is easier to use. A. H.

191. Optical Constants of Rubidium and Cæsium. H. E. Ives and H. B. Briggs. *J.O.S.A.* 27. *pp.* 395–400, *Nov.*, 1937.—In continuation of previous work [see Abstract 3290 (1937)] on Na and K the extinction coefficient and refractive index were determined for Cs and Rb for wave-lengths ranging from 5780 down to 2536 Å. The transmission of the films was also calculated. As illustrating the variation from metal to metal it is of interest to notice that the reflection coefficients at 4047 Å are :—Cs, 12·7% ; Rb, 37·6% ; K, 73·2% ; Na, 94·5%. A. H.

192. Reflectivity of Corrugated Surfaces. L. S. Ornstein and A. van der Berg. *Physica*, 4. *pp.* 1181–1189, *Dec.*, 1937. *In English.*—The scattering of a plane surface, due to small irregularities, is calculated, assuming that the surface is composed of small planes, fortuitously oriented. The probability and the scattering are given in tables. AUTHORS.

193. Refractivity Intercept. S. S. Kurtz, Jr., and A. L. Ward. *Frank. Inst., J.* 224. *pp.* 583–601, *Nov.*, 1937.—In earlier work [see Abstract 5547 (1936)] the relation between refractive index and density of hydrocarbons in the liquid state was examined and a new constant $(n - d/2)$ called the "refractivity intercept" was defined. In view of the close relation between refraction, dispersion and the electronic oscillators in organic molecules it seems reasonable to see what light will be thrown by calculations of the number and characteristic frequency of "dispersion electrons" in various hydrocarbons. Two types of dispersion equation are available, the Sellmeier-Drude and the Lorentz-Lorenz. It is shown that the latter equation is invalid and the former is consequently adopted and used in calculations of the dispersion electrons mentioned above. The interpretation of the refractivity intercept in the light of these calculations shows that the main difference between naphthenes and paraffins is in the number of dispersion electrons per unit volume, not in their frequency of vibration. In the case of aromatics both the number of dispersion electrons and their frequency is less than for saturated cyclics, but the decrease in characteristic frequency is so great that a large refractive index results. A. H.

194. Effect of Pressure on the Refractive Index of CO_2. A. Michels and J. Hamers. *Physica*, 4. *pp.* 95–106, *Nov.*, 1937. *In English.*—In this paper a method is given for the determination of the refractive index of compressed gases. Results of measurements on CO_2 up to 2400 atm. at 25°, 32°, 50° and 100° C., and $\lambda = 6678, 5876, 5016, 4922, 4713$ and 4471 Å are described. AUTHORS.

195. Birefringence Due to Compression of Quartz. G. Bruhat and A. Blanc-Lapierre. *Comptes Rendus*, 205. *pp.* 807–809, *Nov.* 3, 1937.—The birefringence of quartz due to compression was determined for light of wave-lengths 2549–5461 Å with (*a*) propagation and compression both normal to the optic axis, (*b*) propagation normal to both optic and electric axes, compression along the optic axis, and (*c*) propagation as in (*b*) compression along the electric axis. Results indicate that birefringence is independent of direction of compression in the plane normal to the optic axis. In (*b*) and (*c*) it is some 30 times stronger than in (*a*), and slightly stronger in (*b*) than in (*c*). Havelock's formula for dispersion in (*a*) is only a first approximation, giving results differing by at least 6% from experimental. C. A. S.

***196. Dispersion without Deviation of the Mean Ray. H. W. Farwell.** *J.O.S.A.* 27. *pp.* 383–385, *Nov.*, 1937.—This paper shows that a direct vision spectroscope may use a glass prism immersed in a liquid contained in a cell with parallel ends. The effect of changing the prism angle is shown, and the data for a 14° dispersion are given. AUTHOR.

197. Refractive Dispersion of Organic Compounds. Part IX. Optical Exaltation in Unsaturated Hydrocarbons with Conjugated Double Bonds. T. M. Lowry and C. B. Allsopp. *Roy. Soc., Proc.* 163*A*. *pp.* 356–365, *Dec.* 7, 1937.—Optical exaltation appears to be exhibited by a system of two conjugated ethylenic double bonds when these form part of an open chain (*e.g.*, 2 : 4-hexadiene) but not when they are built into a ring (*e.g.*, 1 : 3 *cyclo*-hexadiene). The u.v. absorption bands of conjugated ring systems are displaced towards lower frequencies relative to those of the corresponding open-chain systems. These effects of configuration on the optical properties of a conjugated system are discussed. [For Part VIII see Abstract 669 (1936).] AUTHORS.

SPECTROSCOPY.

198. Spectrum of Silicon. T. Takamine, T. Suga, and M. Kamiyama. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 731. *pp.* 247–271, *Oct.*, 1937. *In English.*—When a strong condensed discharge is passed through a fine quartz capillary in H_2 at low pressure, Si spectra at successive stages of ionisation are seen superposed on the Lyman continuum. The extreme u.v. part of these spectra was studied by means of a vacuum spectrograph having a 1 m. concave grating at grazing incidence. Special features observed were the changing of many of the Si I and Si II lines from emission to absorption with increased energy of the spark. Especially interesting was the marked difference in the degree of easiness for reversal seen for different Si II lines. Lines of Si III and Si IV came out mostly in emission. Relation between the stellar temperature classification and the temperature in the light source used in laboratory experiment is discussed. AUTHORS.

199. Arc and Spark Spectra of Ytterbium. W. F. Meggers and B. F. Scribner. *Bureau of Standards, J. of Research,* 19. *pp.* 651–664, *Dec.,* 1937.—A new description of conventional arc and spark spectra of Yb (neoytterbium, aldeberanium) has been completed in the wave-length range 2000 to 11,000 Å. Wave-length measurements and intensity estimates are presented for 1668 lines, 400 of which characterise neutral Yb atoms (Yb I spectrum), about 1250 are due to singly ionised atoms (Yb II spectrum), and possibly a dozen belong to doubly ionised atoms (Yb III spectrum). Some spectral regularities are given for neutral and for singly ionised atoms. The ground states of Yb, Yb^+, and Yb^{++} atoms appear to be associated with the electron configurations, $4f^{14}6s^2$, $4f^{14}6s$, and $4f^{14}$, respectively. AUTHORS.

200. Probability of Cumulative Excitation of Mercury Atoms. W. Fabrikant and J. Zirg. *Phys. Zeits. d. Sowjetunion,* 12. 3. *pp.* 324–329, 1937. *In English.*—The intensity of lines emitted by the Hg discharge is measured. From its dependence on the electron concentration the probability of cumulative excitation of Hg atoms is calculated. AUTHORS.

201. Displacement of Maximum of Mercury Resonance Line 2536·7 Å. S. Rajski. *Phys. Zeits. d. Sowjetunion,* 12. 3. *pp.* 334–338, 1937. *In German.*—By a study of the intensity distribution in the self-reversed Hg line 2536·7 Å emitted by an over-heated Hg-vapour lamp, it is shown that the shift of the maximum of the line in question due to a pressure of Hg vapour of 7·2 atm. cannot exceed 0·1 Å. W. S. S.

202. Pressure Effects of Rare Gases on the Second Doublet of Rubidium Principal Series. Ny Tsi-Zé and Ch'en Shang-Yi. *Phys. Rev.* 52. *pp.* 1158–1161, *Dec.* 1, 1937.—The displacement, asymmetry, and broadening of the second doublet of the Rb principal series perturbed by pure He, Ne and A up to 13 atm. are observed. The displacement as well as the broadening of the doublet components are not the same. The $^2P_{\frac{1}{2}}$ component shifts and broadens more conspicuously than the $^2P_{1\frac{1}{2}}$ component (an exception being the broadening by A). The departure from linear relationship between the shift and the density of the perturbing gas is quite manifest. Both for He and for Ne the line contour shows a distinct asymmetry towards the violet, while for A the line contour shows a very strong red asymmetry. For He and Ne the violet asymmetries of the $^2P_{\frac{1}{2}}$ component are stronger than that of the $^2P_{1\frac{1}{2}}$ component ; the reverse is true for A. The relationship between the half-width and the relative density is linear for foreign gas concentrations of relative densities up to 8 so far applied. AUTHORS.

203. Intensity Dissymmetry in the Emission of Light from Canal Rays. J. Stark and H. Verleger. *Phys. Zeits.* 38. *pp.* 873–880, *Nov.* 15, 1937. *From the Reichsanstalt.*—A more detailed account is now given of experiments on the axial distribution of light emitted from canal rays. [See Abstracts 3097, 3098 and 3099 (1937).] C. B. A.

204. Low Terms in Cr III, Cr IV, Mn IV and Fe V. I. S. Bowen. *Phys. Rev.* 52. *pp.* 1153–1156, *Dec.,* 1937.—Most of the strong lines arising from the d^3, d^24s and d^24p configurations of Cr IV and the d^4, d^34s and d^34p configurations of Cr III, Mn IV and Fe V have been classified. The presence of forbidden lines of these ions in astronomical sources is discussed. [See also Abstract 3208 (1936).] AUTHOR.

205. Energy Levels of Neon and Argon. J. B. Sampson. *Phys. Rev.* 52. *pp.* 1157–1158, *Dec.* 1, 1937.—The energy levels for the Ne $2p^53d$ and A $3p^55d$ configurations have been calculated completely from

the first-order perturbation theory and compared with the observed values.
AUTHOR.

206. Absorption Spectrum of Water. A. Carrelli. *N. Cimento,* 14. *pp.* 245–256, *June,* 1937.—The infra-red absorption spectrum of water is measured and for comparison the spectra of the aqueous solutions of some salts and that of gypsum containing water of crystallisation are obtained. From these results conclusions as to the classification of the absorption maxima are drawn. R. P.

207. Rotation-Vibration Band of Methyl Fluoride in the Photographic Infra-Red. S. M. Naudé and H. Verleger. *Phys. Zeits.* 38. *pp.* 919–921, *Nov.* 15, 1937. *From the Reichsanstalt.*—The rotation-vibration band of CH_3F at 11,250 Å is obtained with a 4·5 m. grating giving a dispersion of 4·2 Å per mm. It is found to correspond to the Band I of the other methyl halides and is to be ascribed to the vibration $2\nu_2 + \nu_1$. The expected periodic intensity variation is observed. Frequency values are given for the Q-lines, which have a mean frequency difference of 7·6 cm^{-1}. L. A. W.

208. Rotation-Vibration of Molecules Containing Deuterium. Part III. Band of HDO at 1·161μ. L. Herzberg. *Zeits. f. Physik,* 107. 7–8. *pp.* 549–558, 1937.—Continuing previous work [see Abstract 4718 (1936)], the author measures the lines of the 1·161μ band of HDO. The band is analysed as far as possible and the principal moments of inertia of the molecule are determined. The values obtained for the valency angle and the D–O distance differ respectively by 0·6 and 2% from the corresponding values obtained by other workers for the H_2O molecule; but it is doubtful whether these differences are real. L. A. W.

209. Frequency of Oscillations of the OH Group in Methyl Alcohol and its Dependence on Density. G. S. Landsberg and S. A. Ukholin. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 16. 8. *pp.* 391–393, 1937. *In French.*—Experiments on the absorption spectrum of CH_3OH as liquid and vapour at pressures below normal show that the maximum of absorption of the OH band moves from 3402 cm^{-1}. at density = 0·78 to 3535 cm^{-1}. at 0·57, without alteration in the width of the band. A limiting position is reached at a density of 0·04, when the band divides into two components. These results are discussed in the light of similar experiments with water. [See following Abstract.] C. B. A.

210. Dependence of the Combination Spectrum of Water on Density and Pressure. S. A. Ukholin. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 16. 8. *pp.* 395–398, 1937. *In French.*—The effects of variation of density and pressure on the diffuse absorption band of liquid water (maxima at 3215, 3435 and 3580 cm^{-1}.) are investigated. The changes observed are interpreted in terms of the proportions of the three types of water (water I, II or III) present. [See preceding Abstract.] C. B. A.

211. Light Absorption and Absolute Concentration of Hydroxyl. L. Avramenko and V. Kondratjew. *Acta Physicochimica,* 7. 4. *pp.* 567–580, 1937. *In English.*—A heat of reaction of 124 Cal. has been calculated for the reaction $H_2 + 2OH = 2H_2O$ from measurements of the absorption coefficients of the lines Q_1 (9/2) and Q_1 (13/2) of the OH band λ 3064 Å at different temperatures in the mixture 2/3 H_2O + 1/3 O_2. A quantitative relationship between the absorption coefficients and the OH concentration has been established, and from it, the absolute concentration of

OH in the electric discharge in water vapour and in the dilute H_2 flame has been determined. AUTHORS.

212. Absorption Spectra and Structure of Compounds with Visible Colour. P. Ramart-Lucas. *Comptes Rendus,* 205. *pp.* 864–866, *Nov.* 8, 1937.—Examination of the absorption spectra of solutions of red and yellow fluorescein reveals that they contain a mixture of two forms in equilibrium, one of which is quinonic, coloured and fluorescent, the other lactonic, uncoloured and non-fluorescent. The coloured form predominates in alcoholic solutions, and the uncoloured form in etherial solutions. C. B. A.

213. U.V. Absorption Spectra of the Isomers of Butene-2 and Pentene-2. E. P. Carr and H. Stücklen. *Am. Chem. Soc., J.* 59. *pp.* 2138–2141, *Nov.,* 1937.—The u.v. absorption spectra of *cis-* and *trans*-butene-2, cyclohexene and different samples of pentene-2 have been examined in vapour phase in the Schumann region. The marked similarity between the spectra of the higher boiling butene-2 and cyclohexene confirms the earlier assignment of the *cis* configuration to this isomer. The absorption curves for two samples of pentene-2, which from their methods of preparation should give two different geometrical isomers, showed intensity relationships which were entirely analogous to those shown by the *cis* and *trans* isomers of butene-2. These differences were sufficiently marked to serve as a basis for identification of the two isomers ; the higher boiling pentene-2 is the *cis* form. The comparative yields of the two isomers of pentene-2 prepared by four other methods have been estimated from their absorption spectra. AUTHORS.

214. Spectrum of SiF. T. Yuasa. *Tokyo B.D., Sci. Reports,* 3. *pp.* 195–203, *Sept.* 30, 1937. *In French.*—The spectrum was produced by passage of a discharge between Al or W electrodes in an atmosphere of HF, using cryolite as the source of the F. Systems of bands were observed at 3840–3293 Å (degraded to the red), 3414–3245 Å (degraded to the violet), and 3366–3199 Å (degraded to the red). A vibrational analysis of the first of these is given, and the following constants evaluated :— $X_e'\omega_e' = 4 \cdot 1$ cm^{-1}. $\omega_e' = 911 \cdot 2$ cm^{-1}., $X_e''\omega_e'' = 4 \cdot 3$ cm^{-1}. $\omega_e'' = 858 \cdot 6$ cm^{-1}.
H. G. C.

***215. Spectrum of SnF. F. A. Jenkins and G. D. Rochester.** *Phys. Rev.* 52. *pp.* 1135–1140, *Dec.* 1, 1937.—Measurements of the absorption bands of SnF are reported for the first time. Analysis of the frequencies of the band heads shows the presence of four doublet systems, all due to transitions from a doublet normal state X, of separation 2317·3 cm^{-1}. The various states are as follows :

State	ν	ω_e	$x_e\omega_e$	Probable Type
X	0·0	582·9	2·69	$^2\Pi$
	2317·3	587·6	2·65	
A	34,108·4	676·7	2·65	$^2\Sigma$
B	40,834	594	—	$^2\Delta$
C	44,161·6	688·2	4·65	$^2\Pi$
	45,498·9	688·2	4·65	
D	46,326	598	—	$^2\Delta$
	46,427	607	—	
E	~41,000	—	—	—
F	~53,000	—	—	—

The transitions E ← X and F ← X give continua. The second component of B ← X is probably masked by E ← X. Resolution of the Sn isotope effect is observed for the first time. A carbon tube furnace for studying absorption spectra is described. AUTHORS.

216. Extension of Spectrum of AgCl. F. A. Jenkins and G. D. Rochester. *Phys. Rev.* 52. *pp.* 1141–1143, *Dec.* 1, 1937.—The absorption of AgCl vapour below λ 2500 has been investigated with high dispersion. A new band system obeying the formula $\nu_{head} = 43{,}525\cdot4 + 294\cdot1u' - 1\cdot70u'^2 - 342\cdot8u'' + 2\cdot14u''^2$ has been found, and a fragment of another similar system. Strong continuous absorption is observed at higher pressures. AUTHORS.

217. Band Spectrum of TiCl. K. R. More and A. H. Parker. *Phys. Rev.* 52. *pp.* 1150–1152, *Dec.* 1, 1937.—The emission spectrum of TiCl has been excited by both h.f. and l.f. discharges through a continuous flow of $TiCl_4$ vapour in a discharge tube. The spectrum consists of one strong group of bands and several weaker groups, all degraded to shorter wave-lengths. The strong group occurs between 4200 and 4100 Å and the weak groups between 4100 and 3700 Å. The strong group is attributed to a transition between doublet electronic levels. The analysis of this system gives the values $\nu_e = 23820\cdot0$ cm^{-1}., $\omega' = 503\cdot4$ cm^{-1}., $x'\omega' = 2\cdot5$ cm^{-1}., $\omega'' = 456\cdot4$ cm^{-1}., $x''\omega'' = 6\cdot3$ cm^{-1}. AUTHORS.

218. Temperature Determinations from Band Spectral Data. H. P. Knauss and M. S. McCay. *Phys. Rev.* 52. *pp.* 1143–1150, *Dec.*, 1, 1937.—A method of interpreting intensity distributions of lines in a band for determining the temperature of the emitter has been worked out which is independent of photometer calibration. The criterion used is the place in the band where adjacent lines of overlapping branches are of equal intensity, that is, the intersection of envelopes of the microphotometer records for the respective branches of a given band. The temperature is readily determined from graphs showing the temperature as a function of the J values at which the simultaneous requirements of equality of intensity and equality of frequency are satisfied in a given pair of branches. The method has been applied to the (0,1), (0,2), (0,3) and (0,4) bands of the Ångstrom system of CO excited in the electrodeless ring discharge, both at room-temperature and within a furnace at 365° C. Comparison of thermometer indications with the temperatures obtained by this method indicates (*a*) that the rotational energy distributions are characteristic of the temperature of the gas in the source, and (*b*) that the electrodeless ring discharge is a low temperature source of spectra. The error of the new method under favourable conditions may be as small as 5% of the absolute temperature. AUTHORS.

219. Relation between Frequency and Reduced Mass of Diatomic Molecules. A. Carrelli and P. Trautteur. *N. Cimento,* 14. *pp.* 301–309, *July,* 1937.—After a critical review of formulæ for the vibration frequency of diatomic molecules that were previously proposed, the following regularity is shown to hold: If, for metals from any one given column of the periodic system, the vibration frequencies of all known halides are plotted against the inverse square root of the reduced mass of the molecule, the points all fall on a continuous curve which starts as a straight line through the origin and further becomes a parabola. The constants of the straight line and the parabola, and the point at which one law changes into the other, are slightly different for the different columns of the periodic system. A similar curve holds also for the molecules consisting of two halogens. R. P.

220. Two-Quantum States of H_2^+. M. V. Belikov and B. N. Finkelstein. *Phys. Zeits. d. Sowjetunion,* 12. 3. *pp.* 307–312, 1937. *In English.*—The calculation of the two-quantum terms of H_2^+ based on the correct perturbation-theory leads for large internuclear distances to a fairly good agreement with results obtained by the numerical method. AUTHORS.

221. Stability of Polyatomic Molecules in Degenerate Electronic States. Part II. Spin Degeneracy. H. A. Jahn. *Roy. Soc., Proc.* 164*A*. *pp.* 117–131, *Jan.* 7, 1938.—It is shown that a polyatomic molecule cannot possess a stable non-linear nuclear configuration in an electronic state having spin degeneracy unless this degeneracy is the special twofold one which can occur only when the molecule contains an odd number of electrons. Instability caused by the spin alone is shown to be of secondary importance compared with the orbital effects discussed in a previous paper [see Abstract 3603 (1937).] A table gives the irreducible two-valued representations of all the point groups and will be useful in discussion of the electronic states of polyatomic molecules containing an odd number of electrons with spin. AUTHOR.

222. Continuous Absorption Spectrum of Methyl Bromide and its Quantal Interpretation. P. Fink and C. F. Goodeve. *Roy. Soc., Proc.* 163*A*. *pp.* 592–605, *Dec.* 22, 1937.—The extinction coefficients of methyl bromide have been measured over the range 35,000 to 52,000 cm^{-1}. Quantal methods previously applied to the interpretation of continuous absorption bands of diatomic molecules have been extended to the interpretation of the band of methyl bromide. The upper potential energy curve has been calculated and the extinction coefficient curve resolved into parts arising from molecules in various vibrational levels. The analytical method shows the construction of thresholds of continuous absorption. AUTHORS.

223. U.V. Absorption by Organic Substances. L. Marchlewski, W. Bednarczyk and R. Grinbaum. *Acad. Polonaise Sci. et Lettres, Bull.* 3–5*A*. *pp.* 140–200, *March–May,* 1937. *In English.*—In continuation of previous work [see Abstract 1690 (1936)] the u.v. absorption by carbohydrates is investigated in the case of a number of substances. Various fructoses are examined in aqueous solution, in solution in methanol, and in various similar fashions. In general there is continuous absorption with a maximum at 2770–2790 Å. The absorption spectra of a number of organic substances of physiological interest are described, in particular cystine, creatine, creatinine and similar substances. The absorption spectrum of each substance is described. The absorption spectra of phenanthrene and indole and their derivatives are described, along with a further 11 substances. In every case the data were obtained by means of a Spekker-Hilger spectrophotometer, the source of light being a spark between steel electrodes. The bearing of the results on the structure of a number of the substances is briefly discussed. A. H.

224. Nuclear Moment of Barium. A. N. Benson and R. A. Sawyer. *Phys. Rev.* 52. *pp.* 1127–1131, *Dec.* 1, 1937.—New data have been obtained on the hyperfine structure of several lines of Ba. These have been studied in the attempt to determine more definitely the nuclear moment of the odd isotopes of Ba, reported as 2½ by Kruger, Gibbs and Williams, and as 1½ by Schüler and by Murakawa. Studies of the separation of the

$6^2S_{\frac{1}{2}}$ and $7^2S_{\frac{1}{2}}$ components from the centre of gravity, and of the spacing and patterns of the 5^2D_3 and 6^2P_2 terms all lead to the conclusion that I = 1½ is the correct value of nuclear moment. AUTHORS.

225. Stark Effect of Singlet Lines of the Alkaline Earths. B. Svensson. *Zeits. f. Physik*, 107. 7–8. *pp*. 485–492, 1937.—Experimental results are given of measurements of the Stark effect of the 4663 and 6439 Å singlet lines of Cd and the 4630 Å line of Zn. It is sought to correlate the results obtained, together with earlier measurements on Mg and Ca, with Unsöld's theory of the quadratic Stark effect. F. S.

226. New Dissymmetry in the Effect of an Electrical Field on the Hα Line. J. Stark and R. Ritschl. *Phys. Zeits.* 38. *pp*. 870–873, *Nov.* 15, 1937. *From the Reichsanstalt.*—Observations of the Hα line, emitted from a lo-Surdo tube in a strong electric field and viewed across the field, reveal a dissymmetry in the separations of the components produced. C. B. A.

227. Raman Spectrum of Hydrocarbons with Condensed Nuclei. Part II. Dihydro-Anthracene, Acenaphthene, Fluorene. R. Manzoni-Ansidei. *Accad. Lincei, Atti*, 26. *pp*. 166–170, *Sept.*, 1937. Lists of the lines found in the Raman spectra are given. In the spectrum of 9–10 dihydro-anthracene the disappearance of the line 1630 cm^{-1}. of the spectrum of anthracene is notable. The high symmetry of the molecule, as in the case of anthracene, is probably one of the causes of the poverty of lines in the spectrum of this compound, in which the number of lines is nearly equal to that of the anthracene spectrum. Passing from di-hydro-anthracene to fluorene the molecular symmetry loses the centre, the binary axis perpendicular to the molecular plane, and also a binary axis lying in the said plane and possessed by the molecule of dihydro-anthracene, and lacks as well the specular plane containing this last axis. It is concluded from the investigation that the molecular symmetry of the hydrocarbons studied is in accordance with that foreseen by chemists. [For Part I see Abstract 2132 (1937).] J. J. S.

228. Classification of the Raman Lines of Crystalline Quartz. J. Cabannes and C. Bouhet. *Comptes Rendus*, 205. *pp*. 768–771, *Nov.* 3, 1937.—From symmetry considerations a scheme for the Raman lines of crystalline quartz is deduced. This is correlated with the results obtained for the effect in circularly polarised light. H. G. C.

229. Raman Spectra of CH_3OH, CH_3OD, and CH_2DOD. J. O. Halford, L. C. Anderson and G. H. Kissin. *J. Chem. Phys.* 5. *pp*. 927–932, *Dec.*, 1937.—Measurements of the Raman spectra of CH_3OH, CH_3OD and CH_2DOD, produced by the Hg lines at 2536 and 4358 Å units, are analysed to yield a provisional assignment of the fundamental frequencies. The significance of the character of the OH and OD bands to the problem of internal rotation is discussed. A new approximation to a potential constant for the C–O bond is presented. AUTHORS.

✱230. Device for Examination of Line Spectrograms. G. Bolla. *N. Cimento*, 14. *pp*. 257–261, *June*, 1937.—If, in viewing a line spectrogram, the plate is made to oscillate in its own plane and in a direction parallel to the lines, the granular structure of the photographic image is averaged out and the lines stand out with greater clarity. The new device for achieving this object consists of a plane parallel glass plate which is caused to make rotational oscillations about an axis at right angles to the direction of the lines and to the axis of the observing microscope and intersecting the latter axis. W. S. S.

***231. Study of Absorption Spectra by Means of Hartley Figures. C. Dufraisse and J. Houpillart.** *Rev. d'Optique,* 16. *pp.* 321–342, *Oct.,* 1937.—The spectra are photographed in a spectroscope in which the plate is moved at a constant speed in the direction of the image of the slit. This movement is synchronised with a progressive thickness in the absorption tube. The spectra give the shape of the absorption curve, but not its absolute values. Inequalities in the intensity of the source and the absorption of the solvent are corrected for by superimposing a negative of the solution spectrum and positive of the pure solvent spectrum.
H. G. C.

See also Abstracts 58, 196, 197.

TRANSMISSION.

***232. Thermal Transmission of Textiles. R. S. Cleveland.** *Bureau of Standards, J. of Research,* 19. *pp.* 675–684, *Dec.,* 1937.—An apparatus is described for measuring the thermal transmission of textiles. A horizontal plate is heated electrically and maintained at a constant temperature by means of a thermostat. The plate is surrounded by a guard plate which is also maintained at the same temperature to prevent lateral flow of heat into or out of the central plate. A second guard heater is placed below the central plate to prevent the downward flow of heat. The specimen to be tested is laid flat without tension on the apparatus and enclosed in a copper hood placed several inches above it to eliminate the disturbing influence of air currents of the room. Since the thermostatic control results in an intermittent supply of heat to the central heater, an electric clock is added to the circuit, thus automatically adding the periods during which heat is being supplied. The difference in temperature from the central plate to the top of the hood is measured by means of a thermocouple and microammeter. The amount of heat supplied to the central heater per unit of time divided by the difference in temperature from the central plate to the hood and by the area of the hot plate is taken as a measure of the thermal transmission of the specimen. The reproducibility of results, the influence of differences in temperature between the central plate and the guard plates, and the influence of the height of the hood are discussed, and values of thermal transmission for typical fabrics are given. The regulation of temperatures is essentially automatic and little attention is required from an operator except during the 15 min. a test is actually in progress. The hot plates can be operated at any temperature desired. About seven tests can be made in an 8-hr. day, allowing proper time for the attainment of a steady state. The results are usually reproducible to about 1%.
AUTHOR.

233. Transmission of Oxides in the Far Infra Red. M. Parodi. *Comptes Rendus,* 205. *pp.* 906–908, *Nov.* 15, 1937.—The transmission of oxides of the types XO, XO_2 and X_2O_3 is studied by the method of residual rays [see Abstract 2620 (1937)]. Secondary (combination) bands of CoO, CuO and CdO [see Abstract 3519 (1937)] are reported at 28, 30 and 40μ. New bands of TiO_2 MnO_2, MoO_2, and PbO_2 are given as well as bands of Mn_2O_3, Ni_2O_3, Al_2O_3 and Sb_2O_3.
H. G. C.

See also Abstract 191.

VISION.

234. Factors in Dark Adaptation. C. A. Elsberg and H. Spotnitz. *Am. J. Physiol,* 120. *pp.* 689–695, *Dec.,* 1937.—Dark adaptation measurements have been made by determining threshold intensities under various conditions. In particular, the effect of varying the time and intensity of the previous light adaptation has been investigated. W. D. W.

See also Abstracts 153, 182.

X-RAYS.

235. Distribution of X-Rays from a Massive Anti-kathode. H. Determann. *Ann. d. Physik,* 30. 6. *pp.* 481–493, *Nov.,* 1937.—It has long been known that the radiation produced by retardation of electrons shows a definite direction distribution, which depends on the velocity of the kathode rays. The direction of the maximum intensity of the X-rays more rapidly approaches the normal plane the greater the electron velocity. The phenomenon has been experimentally proved for tensions 10–50 kV. The intensity distribution is now studied for electron velocities of 35–140 kV., for directions making angles 0°–110° with the direction of the kathode rays. Filtering the radiation does not affect the position of the intensity maximum, which is also independent of the material of the anti-kathode (Be, C, Al.). The influence of kathode-ray diffusion manifests itself in the increasing overlap of the more and more rapidly advancing maxima, with higher velocities. This overlapping must cause the advance to appear too large. In fact, the observed values finally exceed those calculated from the Sommerfeld theory. For technical X-ray tubes for h.v. operation, it is recommended that the window be set not as usual at 90° to the kathode-ray direction but at a smaller angle. C. J. B. C.

236. Occurrence of "Forbidden" X-Ray Reflections. E. Brandenberger. *Zeits. f. Krist.* 97. 6. *pp.* 476–484, 1937.—The phenomenon of *Umwegreflexion* found by Renninger, [see Abstract 3637 (1937)], which allowed "forbidden" reflections to occur, is studied. Geometrical and physical considerations restrict the number of theoretically possible *umweg* reflections and it is possible to predict which of these will occur. J. T.

237. Focussing of X-Rays with Crystal of Variable Curvature. V. Dolejšek and M. Tayerle. *Comptes Rendus,* 205. *pp.* 605–607, *Oct.* 11, 1937.—A method is described for vertical focussing, by supporting the crystal used for this purpose with two steel springs; thus making it possible to vary the curvature as the crystal under examination is rotated. [See Abstract 5082 (1935).] C. A. S.

***238. Measurement in Absolute Units of the Intensities of X-Ray Reflections from Crystalline Powders. G. W. Brindley and F. W. Spiers.** *Phys. Soc., Proc.* 50. *pp.* 17–29, *Jan.* 1, 1938.—The two methods by which the intensities of X-ray reflections from fine powders can be measured absolutely by comparison with reflections from a standard substance are critically examined. The applicability of the mixture method is limited by the necessity for having powders of extremely small *particle* size, of the order of 10^{-5} cm. or less. In the substitution method, the powders are kept separate and the use of such fine powders is not essential; the absolute accuracy of this method is limited by the fact that the absorption coefficients of the two powders have to be known. Experimental results obtained by the two methods for powders of different particle sizes are compared with theoretical results by Schäfer for the effect of particle size on intensities measured by the mixture method. The agreement between the experimental and the theoretical results is sufficiently close to show the usefulness of Schäfer's analysis in determining the magnitude of the error which may occur when the mixture method is used with powders which are not sufficiently fine. A general account is given of a camera designed for use with the substitution method. It allows an alternating interchange of the two powders with a corresponding movement of the photographic film in order to obtain a separation of the photographs corresponding to the two powders. AUTHORS.

239. Atomic Scattering Factors of Aluminium, Potassium Chloride and Copper for X-Rays. G. W. Brindley and P. Ridley. *Phys. Soc., Proc.* 50. *pp.* 96–107, *Jan.* 1, 1938.—The intensities of X-ray reflections from powders are placed on an absolute scale by comparison with reflections either from KCl or from Al, the absolute values obtained by James and Brindley for these substances being taken as standard values. It is pointed out that the results obtained by standardising with respect to Al are consistently about 10% higher than those obtained when KCl is used as the standard. New determinations of the scattering factors of KCl and Al are made by the powder method, and it is shown that whereas Al values agree well with the previous measurements made by James and Brindley, the new values for KCl differ by an amount which explains the discrepancy mentioned above. The theoretical scattering factors of K^+ and Cl^- are recalculated on the basis of Hartree's latest wave functions, in which allowance for electron-exchange is made. Good agreement is found between the present measurements for KCl and the theoretical results. The scattering factor of Cu^+ also is calculated with and without allowance for electron-exchange, and the results are compared with experimental data for metallic Cu. AUTHORS.

240. Influence of Lattice Binding on the K-Lines of Boron. E. Gwinner and H. Kiessig. *Zeits. f. Physik,* 107. 7–8. *pp.* 449–457, 1937.—The form of the K-lines of B as element and in some of its compounds is determined photometrically and the half-width determined, the blackening curve for the plates employed also being measured at 68 Å. Subsidiary lines with a separation of 15 eV are observed on either side of the principal line with the non-conducting oxide and nitride, but these do not occur in pure boron, its carbide and some borides. C. B. A.

241. Multiple Ionisation of Inner Electron Shells of Atoms. F. K. Richtmyer. *Rev. Modern Physics,* 9. *pp.* 391–402, *Oct.,* 1937.—The study of X-ray satellites and measurements of the widths of X-ray lines and their bearing on the problem of multiple ionisation in X-ray levels is discussed. Satellites are probably due to transitions between energy states arising from doubly (or more generally, multiply) ionised atoms. The experimental work of Parratt is in accordance with the theory ascribing $K\alpha$ satellites to transitions from KL_I to LL ionisation, double ionisation being explained by supposing simultaneous expulsion of two electrons (K and L) by the incident kathode-ray electron by "direct hit." The almost exact agreement between the calculated ratio of the relative probabilities of KL to K ionisation and the ratio of the satellite intensity to that of the "parent" line may be fortuitous, but warrants the conclusion that the satellites do arise from the production of doubly ionised atoms. This hypothesis will not explain the L satellites, but Coster and Kronig have suggested that double ionisation may also arise from an internal photo-

electric effect (*cf.* Auger effect). The widths of X-ray lines also present a problem in that they are much wider than the values calculated on the classical or quantum theories. A theory providing qualitative agreement has been developed by Ramberg, who has calculated the energy states, their widths and hence the widths of the X-ray lines in the Au(79) spectrum.
C. J. B. C.

242. Search for Element 87 (Moldavium). H. Hulubei. *Comptes Rendus,* 205. *pp.* 854–857, *Nov.* 8, 1937.—A detailed discussion is given of the lines of other elements likely to interfere with probable lines of element 87, in particular $L\beta_1$ and $L\beta_2$, of which the author considers that he has seen faint traces. The results of several others are also discussed. [See Abstract 2147(1937).]
C. A. S.

See also Abstract 355.

HEAT.

CALORIMETRY.

243. Heat Capacity of Gaseous Propane, *n*-Butane, Isobutane, and *n*-Pentane. B. H. Sage, D. C. Webster and W. N. Lacey. *Indust. and Engin. Chem.* 29. *pp.* 1309–1314, *Nov.*, 1937.—Isobaric heat capacities at atmospheric pressure were determined for gaseous propane, *n*-butane, isobutane, and *n*-pentane at temperatures from 90° to 320° F. Several diagrams showing the agreement of these measurements with the data of other investigators are included. [See also Abstract 5040 (1937).]
AUTHORS.

See also Abstracts 245, 260, 280, 281, 300.

CONDUCTION.

244. Influence of Magnetic Fields on the Heat Conductivity of Gases. Part IV. H. Senftleben and J. Pietzner. *Ann. d. Physik,* 30. 6. *pp.* 541–554, *Nov.*, 1937.—Previous work on this subject has been published [see Abstract 4769 (1936)]. In the present paper the effect of mixing diamagnetic gases with the O_2 is investigated. The experimental arrangement is briefly described and from the equation $\lambda = \frac{1}{6} fkcvl$ (where λ = the thermal conductivity, f the degrees of freedom of the molecule, k Boltzman's constant, c and l the mean velocity and free path respectively, and v the volume of a molecule in cm^3.) a formula is calculated giving the thermal conductivity of a mixture in terms of those of its constituents, and their molecular weights and diameters. Care has to be taken to ensure that the mixture is homogeneous. It appears that the effect is not connected with the collisions of O_2 molecules with themselves but rather results from the collisions between the O_2 molecules and those of the added gas. Further the effect of the working cross-section and the molecular weight of the added gas lead to the following conclusions :—With gases of similar molecular weight to that of O_2 there is good agreement between the calculated and observed values, but with very light and very heavy gases there is no such agreement. It is suggested that in these cases the effect of the magnetic field is greater on the collisions between O atoms than on the collisions between O_2 molecules and the molecules of the added gas.
E. H. D.

245. Accommodation Coefficients of Noble Gases and Specific Heat of Tungsten. W. C. Michels. *Phys. Rev.* 52. *pp.* 1067–1073, *Nov.* 15, 1937.—By the use of the specific heat theory developed by A. H.

Compton and a simple one-dimensional model, a semi-classical treatment of the problem of the thermal accommodation coefficients for monatomic gases against solid surfaces has been obtained. Application of this theory to the data of Roberts gives a satisfactory fit if the heats of adsorption of He and Ne on W are taken as 50 cal./gm. atom and 278 cal./gm. atom, respectively. The Compton characteristic temperature for W is found to be 148° K, which leads to the conclusion that the excess specific heat of W above the classical value is partially due to anharmonic terms in the potential energy of the atomic oscillators, as suggested by Born and Brody. [See also Abstract 5364 (1933).] AUTHOR.

246. Temperature Variation of Thermal Conductivity and X-Ray Structure of Micas. Part I. Thermal Conductivity up to 600° C. R. W. Powell and E. Griffiths. Part II. X-Ray Examination of Structure. W. A. Wood. *Roy. Soc., Proc.* 163*A. pp.* 189–204, *Nov.* 19, 1937.—In Part I the divided bar method has been adapted for the determination of the thermal conductivities of mica up to a temperature of 600° C. A disc of mica about 1 mm. in thickness is clamped between cylindrical rods of Ni-Cr alloy of known thermal conductivity. To eliminate effects due to oxidation the plane surfaces of the rods are faced with Pt. A correction for temperature discontinuities at the mica metal interfaces is obtained by experiments using extremely thin mica laminæ. Phlogopite micas show, in varying degree, a pronounced decrease in thermal conductivity in the region of 200° C. which is only partially reversible on cooling. The effect is ascribed to the tilting of the elementary crystals of mica on heating. The muscovite micas tested do not show this effect and their thermal conductivity changes but little with temperature. In Part II an X-ray investigation is made of the variation in structure exhibited by certain micas during a cycle of temperature ranging from 16 to 400° C. It is found that the heat treatment may result in a very marked mosaic formation without apparent change in external appearance; that such a structure may not be final, but partially reversible on cooling; and that a close parallelism exists between these structural characteristics and measurements which show an anomalous fall in thermal conductivity at the same elevated temperatures. The thermal expansion of the lattice constant perpendicular to the cleavage plane is measured; from these and from the radial sharpness of high order spectra inferences are drawn in regard to the intrinsic perfection of atomic arrangement in the individual crystallites produced by breakdown of the large-scale crystal. AUTHORS.

DILATATION.

See Abstract 267.

FUSION AND SOLIDIFICATION.

***247. Melting Point of Silicon. F. Hoffmann and A. Schulze.** *Phys. Zeits.* 38. *pp.* 901–905, *Nov.* 15, 1937. *From the Reichsanstalt.*—Many determinations of the melting point of Si have been made but the purity of the specimen was often in doubt. The present paper describes the results of experiments on a specimen of great purity and also on a commercial sample. The determination was first made by thermoelectric methods. The apparatus of quartz is described and also the calibration of the thermocouple, and this is brought into line with the optical temperature scale and checked at the melting points of Au and Pd. The metals are Pt and Pt-Rh. The temperatures were measured by means of a Diesselhorst compensating apparatus and both heating and cooling curves were obtained. The value for the pure specimen (99·89%) was 1411° C. and for the commercial sample (98% Si) 1409° C. Secondly an optical pyrometer method was used. A quartz tube immersed in the molten material is used as a source of radiation and a 90° prism was also used. The difficulties arising and their elimination are discussed at some length. Differently coloured filters were used and Pt foil was also used as a source. The final result for the melting point of Si is given as 1410° C. E. H. D.

248. Melting of Mononitrophenols at High Pressure. R. B. Dow and H. B. Hibshman. *J. Chem. Phys.* 5. *pp.* 960–964, *Dec.*, 1937.—The melting of the mononitrophenols has been studied over a pressure range of 4,000 kg./cm^2. by separate application of a piston displacement and a new dynamic method. By the dynamic method, the procedure was to observe the sudden change of temperature difference as the nitrophenol underwent melting with change of pressure. Comparison of results obtained by the two methods indicate close agreement for the pressure-melting temperature data of ortho- and meta-nitrophenol which have not been studied previously over the present pressure range. Application of the dynamic method is compared briefly with that of the piston displacement method in respect to melting and polymorphic transitions of solids at high pressure. AUTHORS.

249. Correlation of Fluidity Curves with Freezing-Point Curves in Binary Systems. R. H. Ewell. *J. Chem. Phys.* 5. *pp.* 967–973, *Dec.*, 1937.—Binary systems which form crystalline compounds nearly always exhibit negative deviations from the ideal laws for liquid solutions of the type $G = N_1G_1^0 + N_2G_2^0$, where N is mole fraction and G may be volume, heat content, vapour pressure or fluidity. The deviations from ideality are often approximately parabolic functions of the molecular composition with the maximum deviation at or near 50 mole %. In the case of fluidity this type of deviation is observed whatever the composition of the crystalline compound or compounds which occur in the system, leading to the conclusion that there is no correlation between the position of the maximum fluidity deviation and the composition of the crystalline compounds indicated by the freezing-point curve. The bearing of this conclusion on the question of compound formation in the liquid is discussed. AUTHOR.

TEMPERATURE.

250. Temperature Scale below 1°K. W. Jacyna. *Acad. Polonaise Sci. et Lettres, Bull.* 6–8*A*. *pp.* 260–268, *June–Oct.*, 1937. *In German.*—The magnetic method of measuring temperature recently employed by de Haas and Wiersma [see Abstract 3255 (1936)] is identified with Weiss's theory of ferromagnetism. Modern methods of estimating temperatures below 1°K. belong to a category of operations based either on the thermomagnetic equation of state or on the direct application of the second law. In the first case, in consequence of the incompleteness of the thermomagnetic equation, only arbitrary temperature scales can be determined. In the second case, the processes involved do not possess the reversibility necessary to attain the correct result. G. E. A.

251. Gas-Thermometric Data Differences. W. Jacyna. *Acad. Polonaise Sci. et Lettres, Bull.* 3–5*A*. *pp.* 97–108, 1937. *In German.*—

A connection is established between the differences found in the data from gas-thermometric measurements and volume deviations, and the special characteristics of the He thermometer at $t > -100°$ C. are explained by analytical, graphical and tabular treatment. It is shown that the He thermometer at constant pressure is preferable to the constant volume instrument for measurements at $t > -100°$ C. The subject is treated very comprehensively. H. H. Ho.

***252. Measurements of Liquid Helium Temperatures. Parts I and II. G. Schmidt and W. H. Keesom.** *K. Onnes Lab., Leiden, Comm. Nos.* 250*b and* 250*c. Physica,* 4. *pp.* 963–977, *Nov.,* 1937. *In English.*—Part I deals with a new determination of the normal boiling point of He. Use was made of a He thermometer with reduced ice point pressure read by means of a hot wire manometer. A description of the apparatus is given. The boiling point was derived from the H_2 boiling point. The result was 4·216° K. In Part II new measurements on the vapour pressure curve of He were made. They gave temperatures which throughout are slightly higher than those calculated according to the formulæ which form the basis of the temperature scale 1932, to a maximum of 0·026 degree for He II at 1·6° K., and of 0·015 degree for He I at 3·5° K. Table IV gives a survey of the differences $T - T_{1932}$. The λ-point was more accurately determined to lie at $p = 3{\cdot}83$ cm. Hg, $T = 2{\cdot}186°$ K ($\pm$ 0·002). AUTHORS.

***253. Radiation Thermopiles. A. H. Pfund.** *Rev. Sci. Instruments,* 8. *pp.* 417–419, *Nov.,* 1937.—Thermopiles of the type to be described have been made for many years. The sole purpose of the present note is to set forth the technique which has been developed for the making of the junction. The theory of thermopiles as well as the construction of other types is covered by a fairly complete Bibliography at the end of the paper. In the present procedure of forming the actual "junction," no solder whatsoever is used; furthermore, the number of failures is reduced to a minimum. The mode of mounting is based on a study of those thermopiles which still survive after a long and active life. AUTHOR.

***254. Apparatus for Measuring Surface and Body Temperature. J. D. Hardy and G. F. Soderstrom.** *Rev. Sci. Instruments,* 8. *pp.* 419–422, *Nov.,* 1937.—A radiometric device adapted to the measurement of temperatures of black surfaces is described. The precision of the instrument is such that surface temperatures may be measured to $\pm$ 0·01° C. The apparatus has been used for the measuring of skin temperatures in humans. With the thermoelectric body thermometer, also described, the apparatus is ideal for studying thermal changes in the human body. AUTHORS.

See also Abstracts 218, 247 and

83B. Electric Resistance Thermometers. H. Lindorf.

THERMOCHEMISTRY.

255. Combustion Levels in Flame Gases. W. T. David. *Engineering,* 144. *pp.* 531–533, *Nov.* 12, 1937.—A further account of the results of the author's experiments [see Abstracts 1264 and 4793 (1936)] which he considers to indicate the existence in flame gases of a long-lived latent energy, probably the result of the formation of metastable molecules in the flame front. The term "combustion level" is introduced, by which is meant the ratio of the energy which can be accounted for in the flame gases on the assumption that they are normal gases to the heat of combustion of the original fuel mixture. The combustion level is given by (100-L.E.) where LE is the latent energy expressed as a percentage of the heat of combustion. Data are tabulated showing that combustion levels ranging from 72 to 99%, have been obtained, and it is anticipated that subsequent work will lead to an extension of this range. R. W. P.

256. Heats of Ionisation of Water, Ammonium Hydroxide, Carbonic, Phosphoric, and Sulphuric Acids. Variation of Ionisation Constants with Temperature and the Entropy Change with Ionisation. K. S. Pitzer. *Am. Chem. Soc., J.* 59. *pp.* 2365–2371, *Nov.*, 1937.

See also Abstracts 52, 211, 269.

THERMODYNAMICS.

***257. P.V.T. Properties of Nitrogen at High Density. Parts I and II. M. Benedict.** *Am. Chem. Soc., J.* 59. *pp.* 2224–2242, *Nov.*, 1937.—In order to advance our knowledge of the properties of the liquid and gaseous states of aggregation it is desirable to have P.V.T. data on at least one substance over as wide a range of temperature and pressure as is experimentally possible. These papers give the results of experiments on the density of N over the pressure and temperature range not covered previously up to 5000 atm. and between 200° C. and the temperatures at which the fluid phase freezes. The results are given in Amagat units, *i.e.*, the unit of temperature is the degree Centigrade, of pressure the international atmosphere, and the unit of density is the density of N at O° C. and at 1 int. atm. Part I deals with results obtained by means of a weight piezometer. Full details of the apparatus and the derivation of the results are given. An equation of state was fitted to the new and all other available data on N between −45° and −208° C. at densities from 210 to 750 Amagat units. The Joule-Thomson inversion curve for N has been calculated from the equation of state and is found to agree with the work of Roebuck and Osterberg. The density of N at 0° C. and 1550 atm. has been determined as a reference datum for work at higher pressures. Part II describes the results obtained by a piston displacement method for determining the density relative to the above datum. The specific volume was measured from 980 to 5800 atm. and from −175° to −200° C. An equation of state has been fitted to these volumes and Bridgman's freezing curve for N has been checked and represented by a quadratic equation. Various consequences of the equation of state have been discussed and some thermal data have been derived from it. Of these the velocity of sound should prove useful as a check on the P.V.T. data. E. H. D.

258. Quantum Theory of the Non-Ideal Gas. Part II. Behaviour at Low Temperatures. E. Beth and G. E. Uhlenbeck. *Physica,* 4. *pp.* 915–924, *Nov.*, 1937. *In English.*—The considerations on the second virial coefficient B (T) given in Part I [see Abstract 4283 (1936)] have been extended by taking into account the influence of Bose or Fermi statistics and of discrete quantum states (existence of polarisation molecules). The expression for B_l could be simplified by carrying out the integration over *r* also for a general interaction potential U (*r*). This, at least in certain limiting cases, allows the discussion of the behaviour of B (T) at low temperatures. AUTHORS.

259. Van der Waals Forces. A. J. Staverman. *Physica,* 4. *pp.* 1141–1154, *Nov.*, 1937. *In English.*—A general method is given to distinguish for a given molecule between the contributions of dispersion, induction and orientation effect to its cohesive forces from data on heat of evaporation and of mixing. It is shown, that the cohesive forces of a molecule in all media can be described by at most four constants, viz. one for the dispersion energy, one for the induction energy and two for the orientation energy. For that purpose general definitions of the induction and orientation energy are given in which the dipole moment does not appear. Qualitatively the method explains several experimental results while it shows that it is possible to see all electrostatic links, from the links between dipole molecules to ion links, from one point of view. There appears to be one origin for the heat generation at mixing of chloroform and acetone and the energy of formation of $BaSO_4$; between these extremities many intermediate stages exist: hydrates, ammoniates, oxonium compounds and many others. Quantitatively the method becomes useful only when many heats of mixing are measured in order to obtain a sufficient excess of equations with respect to the number of unknown quantities. There are, however, some preliminary calculations made from which it follows that the orientation energy of the alcohols is 5300 cal. and the induction energy 1200 cal. AUTHOR.

260. Entropy of Isoprene from Heat-Capacity Measurements. N. Bekkedahl and L. A. Wood. *Bureau of Standards, J. of Research,* 19. *pp.* 551–558, *Nov.,* 1937.—Measurements of heat capacity were made on a sample of isoprene of high purity from 20 to 300° K. with an adiabatic vacuum-type calorimeter. At 20° K. the heat capacity of the crystalline material was found to be 11·8 j./(mole·degree), and with increase in temperature the heat capacity increases, following the usual type of curve for crystalline substances. At 100° K. the heat capacity of the solid is 64·7 j./(mole·degree), and at the melting point, 126·4° K., the heat of fusion is determined to be 4,830 ± 15 j./mole. The heat capacity of the substance increases about 60% during the change from solid to liquid. Above the fusion temperature the curve is characteristic of liquids, and the heat capacity attains a value of 152·6 j./(mole·degree) at 298·2° K. (25° C.). Utilisation of the data, according to the third law of thermodynamics, yields 229·3 ± 1·0 j./(mole·degree) for the entropy of isoprene at this temperature. [See also Abstract 259 (1936).] AUTHORS.

261. Thermodynamics in Hydrocarbon Research. C. L. Thomas, G. Egloff and J. C. Morrell. *Indust. and Engin. Chem.* 29. *pp.* 1260–1267, *Nov.,* 1937.—The differences between thermodynamic data from calorimetric measurements and those calculated from Raman and infra-red spectra are discussed. The new equation, $\Delta F^{\circ}_f = -10{,}550 - 5{,}890n + 25\cdot 2nT - 2\cdot 2T$ $(n > 1)$ has been derived for straight-chain paraffin hydrocarbons. Similarly, the new equation $\Delta F^{\circ}_f = 20{,}321 - 5{,}835n - 33\cdot 26T + 24\cdot 52nT$ $(n > 2)$ has been derived for straight-chain olefins with the double bond in the terminal position. A table of standard free-energy values for 42 hydrocarbons at 298°, 500°, and in some cases at 1000° K. is given. These data may be used to decide whether a reaction is thermodynamically possible, and what temperature is advisable for finding a catalyst for the reaction. [See also Abstract 1742 (1937).]

AUTHORS.

262. Expressions for First Partial Derivatives of Thermodynamic Functions. F. Lerman. *J. Chem. Phys.* 5. *p.* 994, *Dec.,* 1937.—A correction. [See Abstract 5042 (1937).]

263. Thermodynamic Properties of Anhydrous Chlorides of Chromium. H. A. Doerner. *Bureau of Mines, Techn. Paper No.* 577. [51 *pp.*], 1937.—Data are presented for the vapour pressures of $CrCl_2$ up to the boiling point, 1302° C., and the equilibrium constants of the reaction $CrCl_2 + H_2 = Cr + 2HCl$ over the same range. The experiments actually range from 700 to 1000° C. and below the melting point, 815° C., the vapour pressure, p, is given by $-4\cdot575T\log p = 64{,}000 + 2\cdot83T\log T + 2\cdot65 \times 10^{-3}T^2 - 56\cdot068T$ whilst above, by $-4\cdot575T\log p = 63{,}080 + 23\cdot0T\log T - 113\cdot595T$. The vapour and dissociation pressures of $CrCl_3$ are given up to 947 and 1126° C. respectively, the experiments in this instance covering the range 700 to 900° C. The two static and the two dynamic methods of measuring vapour pressures which are used in this work are described. In the case of $CrCl_3$ both types of experiment give a higher apparent vapour pressure in the presence of Cl than in a vacuum or inert gas, and it is considered that a gaseous tetrachloride is formed according to the reaction, $2CrCl_3 + Cl_2 = 2CrCl_4$. The equilibrium constants of this reaction are tabulated up to 1126° C. A table of specific heats, heats of formation and free energies, contains the unpublished results of Anderson for $CrCl_2$ and $CrCl_3$ in the solid state, and estimated values for the liquid and gaseous states. R. W. P.

264. Thermodynamics of Aqueous KCl-LiCl Mixtures. B. B. Owen and T. F. Cooke, Jr. *Am. Chem. Soc., J.* 59. *pp.* 2273–2276, *Nov.*, 1937.—The variation of the vapour pressures of solutions of LiCl and KCl, in various proportions, and at constant total molalities (1, 2, and 3 *M*), has been determined by the isopiestic method at 25°. It was found that the osmotic coefficient is a quadratic function of the relative composition. The results are in general agreement with relevant data in the literature, and with Scatchard's formulation of the specific ion interaction theory. AUTHORS.

265. Thermodynamics of Aqueous HCl-HBr Mixtures. B. B. Owen and T. F. Cooke, Jr. *Am. Chem. Soc., J.* 59. *pp.* 2277–2279, *Nov.*, 1937.—The Ag-AgBr electrode was studied in mixtures of HBr and HCl and found to give reproducible results over a sevenfold change in relative concentration. Log γ for HBr was determined in the mixtures at constant total molality from 0 to 45°. It was shown to vary linearly with relative concentration. The rate of variation decreases with rise in temperature, but is practically independent of concentration between 0·5 and 1 *M*. The rate of variation of log γ for HCl in the mixtures was estimated, and found to be of the same order of magnitude as that for HBr, but of opposite sign. Its temperature coefficient is also negative. AUTHORS.

See also Abstracts 26, 54, 75, 243, 256, 266, 327.

VAPORISATION AND CONDENSATION.

266. Superheating of Liquids. W. Döring. *Zeits. f. phys. Chem.* 38. *Abt.B.* 4. *pp.* 292–294, 1937.—Corrections to the original article. [See Abstract 4593 (1937).]

***267. Expansion of Vapours and Efficiency of Distillation. W. Świętosławski and E. Ramotowski.** *Acad. Polonaise Sci. et Lettres, Bull.* 3–5*A*. *pp.* 131–139, *March–May*, 1937. *In English.*—In order to examine the influence of expansion of vapours on the efficiency of distillation, an apparatus consisting of four dephlegmators, connected by means of narrow joining tubes, was constructed. The vapours pass from one dephlegmator to the next through the narrow tubes; this produces a difference in pressure and an expansion of vapours when passing from one part of the apparatus to the other. Rectifications of pure commercial CCl_4 and of CCl_4 contaminated with 0·538% and 1·922% of $CHCl_3$ were carried out. As a result, preparations of the highest degree of purity were obtained. The investigations prove that the expansion of vapours increases considerably the efficiency of distillation. Authors.

268. Equilibration of Liquid and Vapour on a Rectifying Pan. M. Ruhemann. *Physica*, 4. *pp.* 1157–1168, *Nov.*, 1937. *In English.*—Bożnjakowić's kinetic equations for the interaction of a binary liquid with its vapour are applied to determine the time needed for bubbles of vapour to attain equilibrium with a liquid through which they are rising. The resulting formulæ are employed to compute the efficiency of rectifying pans in an air separating plant, and the results compared with the actual efficiency of the column. Author.

269. Vapour Pressure and Dissociation of Tungsten Hexachloride in the Gas Phase. A. A. Vernon. *Am. Chem. Soc., J.* 59. *pp.* 1832–1833, *Oct.*, 1937.—The vapour pressure of WCl_6 is determined from 25 to 150°. The heat of vaporisation is 1198 cal./mol. and the change of vapour pressure with temperature is given by the equation $\log p = 3{\cdot}1 - (1198/T)$. An experimental method for the determination of the equilibrium constants of the dissociation is described. The equilibrium constants are determined at 1087, 1227, 1327 and 1727° and the heat of dissociation found to be approximately 9000 cal. Author.

270. Pressures of Permanent Gases at Low Temperatures in Presence of Silica Gel. R. Delaplace. *Comptes Rendus*, 205. *pp.* 664–665, *Oct.* 18, 1937.—The pressures of O_2, N_2, CO and CH_4 in presence of silica gel were determined for every second degree between −182° and −164°, −178° and −144°, −160° and −140°, and −168° and −134° respectively. From these it is deduced that separation of O_2 and N_2 from CO and CH_4 would be easy, the pressures at *e.g.*, −164°, of O_2, N_2, and CH_4 being respectively 95, 8 and 1·5 baryes, while that of CO is inappreciable below −160°. C. A. S.

***271. Ball Packings for Laboratory Rectifying Columns. A. R. Glasgow, Jr. and S. T. Schicktanz.** *Bureau of Standards, J. of Research*, 19. *pp.* 593–603, *Nov.*, 1937.—The efficiency, liquid hold-up, and surface area of packings composed of glass balls 2·95 and 3·80 mm. in dia., lead balls 2·05 and 4·05 mm. in dia., and copper balls 4·00 mm. in dia., have been determined. The description and operation of the glass experimental column are given. For a column 2·6 cm. in dia. packed with balls 0·2 to 0·4 cm. in dia., it is found that: (1) the heat conductivity and the nature of the material of the packing have no effect on the efficiency of separation, liquid hold-up, or through-put of the still; (2) the efficiency is substantially directly proportional to the total surface area exposed in the packed column, and approximately linear with the reciprocal of the diameter of the balls; and (3) the hold-up is approximately linear with the total surface area. Authors.

***272. Hydrogen Liquefier. J. E. Ahlberg, I. Estermann and W. O. Lundberg.** *Rev. Sci. Instruments*, 8. *pp.* 422–426, *Nov.*, 1937.—By using a "twisted tube" heat interchanger, it has been possible to build a small hydrogen liquefier of great simplicity and efficiency, which can be operated from commercial hydrogen cylinders without the use of a compressor and delivers about 1 l. of liquid hydrogen per hr. AUTHORS.

See also Abstracts 76, 129, 171, 252, 263.

ACOUSTICS.

273. Vibrations of Free Circular Plates. Part I. Normal Modes. Part II. Compounded Normal Modes. Part III. Chladni's Original Figures. M. D. Waller. *Phys. Soc., Proc.* 50. *pp.* 70–76, *Jan.* 1, 1938.—In Part I (pp. 70–76) the normal vibrating modes of free circular plates have been determined over an interval of more than six octaves, the solid-CO_2 method of excitation being used to produce the nodal figures, and a valve oscillator to measure their frequencies. It is concluded that the nodal system of ideally uniform and entirely free plates would, in accordance with theory, consist only of circles, diameters and combinations of circles and diameters. It is found that although each simple mode has its characteristic frequency, cases occur in which the difference between two or even three of these is very small, and the number of nodal diameters, which as regards raising the pitch are approximately equivalent to one nodal circle, increases from two to five, in the interval investigated, in passing from figures with relatively more circles to those with relatively more diameters. The expression, based on approximate theory, for calculating the frequencies of the higher modes, in which it is assumed that the addition of two nodal diameters increases the frequency by as much as one nodal circle, is accordingly not applicable in ordinary practice. It is suggested that the simple and rapid solid-CO_2 method of exciting free vibrations might be employed for testing the uniformity of plates, for detecting internal flaws, for studying recrystallisation phenomena, and for obtaining comparative values of Poisson's ratio of metals and alloys. In Part II (pp. 77–82) the many nodal designs (other than those consisting solely of circles and diameters) which are obtained on free circular plates are shown to consist of two or more compounded normal modes of vibration, the periods of which are very nearly equal. The vibration frequencies corresponding to the designs are intermediate between those of the combining modes. The figures are produced as a result of the slight divergence of free periods which exists in all but ideally uniform plates. An increase in damping, either internal or arising from the manner of support or of excitation, also favours the production of these designs, since it renders the resonance less sharp. Compounded modes of a somewhat similar character may be expected to occur in other systems of revolution, such as circular plates clamped at the edge, circular membranes, rings and cymbals, in all of which the normal nodal system consists of combinations of circles and diameters. In Part III (pp. 83–86) the complete set of figures which Chladni produced on circular plates has been examined. It has been found that a second subsidiary normal vibrating mode, the nodal system of which consists of diameters, is in many of the figures compounded with a principal figure of nearly identical period. The manner of support and the manner of excitation make such combinations likely. AUTHOR.

274. Theoretical and Experimental Determinations of the Flexural Oscillations of a Freely Oscillating Elliptic Plate. B. Pavlík. *Zeits. f. Physik*, 107. 7–8. *pp.* 458–462, 1937.—Ritz's formula is applied to determine the position of the nodal lines in the characteristic flexual oscillations of an elliptic plate, for the first seven simplest modes. When the vibrations of a stainless-steel plate are excited by mangetostriction and the nodal planes determined by dust figures, good agreement is seen between theory and experiment. The ratio of any frequency to that of the fundamental is shown to agree with the theory for the five lowest tones but for the sixth and seventh, Ritz's formula gives values considerably higher than those obtained experimentally. Comparision with Goldmann's values is not possible since hyperbolic lines and modes do not appear from his formula. H. M. B.

275. Modulation of Electric Current by Variable Flames. Z. Carrière. *Rev. d'Acoustique*, 6. *pp.* 24–50, *Jan.–March*, 1937.—An account is given of the production of sensitive and singing flames. It is shown that by placing an electrode, maintained at a potential of about 1000 V, near the blue region of the flame, the oscillations can be detected as a musical note in a telephone. The optimum conditions of this effect are examined. It was not possible to obtain frequencies higher than about 5000. J. E. R. C.

276. Mechanical Action of Violins. F. A. Saunders. *Acoustical Soc. of America, J.* 9. *pp.* 81–98, *Oct.*, 1937.—A discursive account of experimental work on the action of the bow and similar topics. W. H. G.

277. Periodicities in Images of Ultrasonic Waves. E. Hiedemann and E. Schreuer. *Zeits. f. Physik*, 107. 7–8. *pp.* 463–473, 1937. It is pointed out that the "coherence" effects reported by Bär [see Abstract 270 (1936)] can be very simply explained by allowing for the changes in frequency of the light which occur when it is diffracted from a progressive wave of ultrasonic radiation, *viz.*, the Doppler effect change and the modulation effect. It is noted that the interference systems can be located in a number of planes behind the fluid which contains the ultrasonic radiation and it is recalled that similar effects can be obtained with the ordinary diffraction grating. Winklemann's explanation of the optical effect is adapted to explain the ultrasonic phenomena. J. E. R. C.

278. Interference Phenomenon with Supersonic Waves. E. Schreuer and K. Osterhammel. *Zeits. f. Physik*, 107. 7–8. *p.* 560, 1937.—A correction. [See Abstract 5048 (1937).]

279. Wave Field of a Piezo-Quartz Radiator. S. N. Rževkin. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 16. 5. *pp.* 267–270, 1937. *In English.*—Stroboscopic examination of the pattern of the ultrasonic waves radiated from quartz plates immersed in oil. P. V.

***280. Ultrasonic Velocity in Gases Between 1 and 100 Atmospheres. A. H. Hodge.** *J. Chem. Phys.* 5. *pp.* 974–977, *Dec.*, 1937.—An acoustic interferometer of the resonator or driven type has been developed for the study of the behaviour of ultrasonic waves in gases under pressures ranging from vacuum to several hundred atm.; measurements of acoustic velocity at several frequencies and in several gases at pressures ranging from 1 to 100 atm. have been made. Increase of velocity with pressure was found for air, N_2, He, and H_2, a decrease for CO_2, the approximate pressure and velocity ranges being respectively as follows: air, 1–101 atm., 347–371 m/sec.; N_2, 1–102 atm., 353–380 m/sec.; CO_2, 1–63 atm., 270–198 m/sec. The He and H_2 were known to be impure. For them an increase in velocity nearly linear with pressure was found. Using frequencies from 88 to 499 kc. dispersion was found for CO_2 at atmospheric pressure, but almost entirely disappeared above 8 atm. The availability of this method for the indirect determination of specific heats is shown. [See following Abstract.] AUTHOR.

281. Ratio of Specific Heats of Air, N_2, and CO_2 as a Function of Pressure by the Ultrasonic Method. J. C. Hubbard and A. H. Hodge. *J. Chem. Phys.* 5. *pp.* 978–979, *Dec.*, 1937.—Measurements have been made by Hodge of ultrasonic velocities at 27° C. at pressures from 1 to 100 atm. in air and N_2 and at 1 to 60 atm. in CO_2. The results for air and N_2 combined with the respective compressibility data of Holborn and Otto give at 27° C. for air, values of γ between 1·406 at 1 atm. and 1·580 at 100 atm., and for N_2, 1·403 at 1 atm. to 1·564 at 100 atm. The acoustic velocities in CO_2 combined with the compressibility data of Amagat, give for γ at 27° C. values from 1·304 at 1 atm. to 3·524 at 60 atm. These and the other results between these limits are in excellent general agreement with the few results in this temperature and pressure region available for comparison. [See preceding Abstract.] AUTHORS.

282. Electro-Acoustical Musical Instruments. V. Aschoff. *Naturwiss.* 25. *pp.* 598–601, *Sept.* 10, 1937.—A short account of the various modern instruments in which the sources of musical tones are electrical generators. Attention is directed to the principles rather than to the details and the illustrations are diagrammatic only. W. H. G.

283. Vowel Characteristics. P. R. Farnsworth. *Acoustical Soc. of America, J.* 9. *pp.* 152–155, *Oct.*, 1937.—A study of the chord-tone-resonance theory of vowels carried out for the vowels, *ōō, ŏŏ, ō, ô, ŭ, ā, ä, ĕ, û, ă, ĭ* and *ē*. Relatively pure tones from a beat frequency oscillator and representing roughly the first two overtone bands of the vowels were used. 196 observers were involved. The results cannot be briefly summarised. W. H. G.

284. Vowel Structure. A. Gemelli. *Pont. Acad. Sci., Comm.* 1. 1. *pp.* 1–39, 1937.—The author considers the common character of all the vowels, lays down fundamental bases of vowel-structure, critically studies acoustic recording and describes in detail his own experimental researches. The direct-reading frequency meter suitable for high-speed recording gave good results. High-speed level recorders, due to Wente, Bedel and Schwartzel, the level-meter of Braunmühl and Weber and a crest voltmeter designed by Sacerdoti were used. Great care was taken to isolate the camera acoustically, particularly from building-vibration. Reverberation is of the order 0·005 sec., while phonic isolation approximates 87 db. Oscillographic registration is by Loewe, v. Ardenne and R.C. kathode-ray oscillographs, film speeds of 3–5 m./sec. being found adequate. Condenser and piezoelectric microphones were used. Frequent calibration ensured correct recording over the range 30–10,000 c.p.s. Ultimate calibration rested on tuning-forks and oscillators. Oscillograms are very well reproduced in an Appendix. Documentation is very thorough. Circuit diagrams are not given. Vowel sounds are found ultimately to resolve into *a, i, u*. J. E. B.

285. Nonlinear Transmission Characteristics of the Auditory Ossicles. O. Stuhlman, Jr. *Acoustical Soc. of America,* J. 9. *pp.* 119–128, *Oct.*, 1937.—From studies of a large scale model it is concluded that a simple harmonic motion impressed at the end of the manubrium transmits both the displacement and the force components in an asymmetrical and non-linear way to the footplate of the stapes provided that the amplitudes are not too small and that the malleus-incus joint is not rigidly locked. W. H. G.

286. Nature of Fatigue in the Auditory System. R. C. Parker. *Phys. Soc., Proc.* 50. *pp.* 108–118, *Jan.* 1, 1938.—The ear is fatigued by a note of known frequency and known absolute intensity. The decrease in aural sensitiveness caused by exposure to this note is found by making a series of threshold measurements at short consecutive intervals after the cessation of the sound. The note used for threshold measurements is 410 c./sec., while for the fatiguing note both this frequency and others, within a range of 25 c./sec. to either side, are used, at two widely separated levels of intensity. When threshold determinations are made at the frequency of the fatiguing note, the duration of the auditory fatigue increases with the intensity of the fatiguing stimulus to attain rapidly a maximum value. At any frequency below or above that of the fatiguing note, the duration of the fatigue again increases with increase in the intensity of the fatiguing tone, but does so less quickly. The range of frequency over which auditory fatigue is apparent decreases as the intensity of the stimulus decreases. The results are shown to be consistent with the resonance theory of hearing. AUTHOR.

See also Abstracts 27, 167.

ELECTRICITY AND MAGNETISM.

ALTERNATING-CURRENT NETWORKS.

See Abstracts 317, 366, 367 and

74B. A.C. Compensation Arrangement. W. Oesinghaus.

76B. Electrical Measuring Bridge. P. G. Cath.

CONDUCTION AND DISCHARGE IN GASES.

287. Theory of Motion of Electrons in Gases and Semiconductors. B. Davydov. *Phys. Zeits. d. Sowjetunion,* 12. 3. *pp.* 269–300, 1937. *In English.*—Even if the external field is so strong that the effective temperature of the electron gas is considerably increased, the electrons make, on the average, many elastic collisons before making a collision that changes their energy appreciably and therefore even in such strong fields the velocity distribution of the electrons is still nearly isotropic. The kinetic equation is formulated and discussed, without assuming the field to be weak, but assuming that the gradient of the field and the gradient of the electron density do not exceed certain limits. If there is no magnetic field present, the solutions of the equations are identical with those usually obtained for a weak field. The modifications introduced by a magnetic field are discussed. The influence of the long-range electrostatic forces between electrons and ions is discussed. The results are applied to the positive column. In that case the velocity distribution is always Maxwellian irrespectively of the electrostatic forces. The general case of a Maxwellian distribution with an abnormal temperature in an electric and a magnetic field is discussed and the coefficients of diffusion, mobility and thermal conductivity are obtained. R. P.

288. Influence of Electric and Magnetic Fields on Electric Sparks in Air at Atmospheric Pressure. L. Bull and P. Girard. *Comptes Rendus,* 205. *pp.* 846–847, *Nov.* 8, 1937.—Electric sparks are made by discharging a 0·001 μF condenser across a 2 mm. gap and photographed by reflection from a rapidly rotating mirror on to a photographic plate, the image moving across at 13 km./sec. An electric field causes a slight regular convexity of the spark towards the anode, but for a magnetic field usually no curvature is seen, although occasionally the bend may be considerable. This is probably due to an electron with a large free path and this phenomenon must be considered in connection with the mechanism of an electric spark. H. M. B.

289. Discharge of a Condenser across a Tube of Gas. J. Bethenod. *Comptes Rendus,* 205. *pp.* 727–730, *Oct.* 26, 1937.—The hypothesis [see Abstract 5060 (1937)] that a tube of gas can be treated as having a constant resistance when it is in the charging circuit of a condenser, is stated not to be tenable when an alternating charging current is used. In studying a similar problem two cases are considered, firstly where the self-inductance of the circuit is negligible and secondly, where the resistance is very small. G. O. B.

290. Kathode Region in the Glow Discharge. A. K. Brewer and J. W. Westhaver. *J. of Applied Physics,* 8. *pp.* 779–782, *Nov.,* 1937.—Measurements have been made in glow discharges in N, A, H_2 and He, of the length of the negative glow and Crookes dark space and the potential drop across the Crookes space over a wide current and pressure range. The energy distributions of electrons entering the negative glow were measured by means of a deflection method. It is concluded that the energy of electrons entering the negative glow corresponds closely to the entire kathode potential fall, and that only a small fraction of the electronic energy is expended in the Crookes dark space. Calculations of the number of positive ions in the dark space per electron of current give a value of less than one per electron compared with 50 to 100 estimated by other investigators. A possible mechanism for the kathode region is briefly outlined. J. E. R.

***291. Behaviour of an Osglim Lamp. Part III. L. F. Richardson.** *Roy. Soc., Proc.* 163*A*. *pp.* 380–390, *Dec.* 7, 1937.—Two osglim lamps wired in parallel with one another can be so arranged that the glowing of either inhibits the other. This arrangement is called a " distraction circuit." The lamps are connected through suitable resistances to a battery. An extra stimulus is required to start the extinct lamp, but if a condenser is suitably connected, the apparatus becomes entirely automatic, one or other lamp flashing in a random sequence, but never both lamps together. Although the glowing gas is quite unlike anything in the nervous system, it seems probable that the abstract time relations of the distraction circuit may be similar to those of a number of pyschological and physiological phenomena, such as distraction, or alternations of perspective in line drawings, or reciprocal inhibition. Experiments with these distraction circuits provide many delicate tests of theories of the osglim lamp. It is shown that the negative slope of the equilibrium potential $\phi_e(u)$ taken in conjunction with the approximate intrinsic equation $\phi = \phi_e(u) + bd\log u/dt$, in which u is current, t time and b is a positive constant, together suffice to explain many of the observed effects, but that these hypotheses are inadequate to account for observations; which, however, could be explained by the presence of a term of higher order, such as $kd\phi/dt$, where $k > 4 \times 10^{-5}$ sec. [For Parts I and II see Abstract 5068 (1937).] AUTHOR.

292. Excitation Potentials of the N_2 Levels $B^3\Pi$ and $C^3\Pi$. R. Bernard. *Comptes Rendus,* 205. *pp.* 793–794, *Nov.* 3, 1937.—Excitation of these levels by electron bombardment of pure N_2 give excitation potentials 2 V higher than spectroscopic values. If the N_2 is mixed with He or Ne values are 11 V for $C^3\Pi$ level and 7·5 V for $B^3\Pi$ level. H. G. C.

293. Effect of Metastable Atoms on the Current in a Non-Self-Sustaining Ne Discharge. I. I. Glotov. *Phys. Zeits. d. Sowjetunion,* 12. 3. *pp.* 235–255, 1937. *In German.*—A neon discharge tube is described in which observations are made on the effects of adding small quantities of A to the gas. It is shown that the discharge current is critically dependent on the percentage of A present. At 50 V the presence of $5 \times 10^{-4}\%$ of A causes a current increase of 17%. The current increases rapidly with the A concentration up to 1% and then begins to fall. The effect is explained as the result of an increase of volume ionisation coefficient due to collisions of the second kind; the decrease at higher concentrations being due to inelastic collisions of electrons with A atoms. Irradiation of the discharge by Ne light decreases the discharge current. This effect depends on the A concentration, reaching a maximum at 0·01% A and falling to zero at 0·2 to 0·3% A. At constant concentration, the radiation effect increases with electrode separation and gas pressure. This effect is due to surface and volume ionisation of the metastable Ne atoms. J. E. R.

294. Ionisation Coefficients in Pure Ne and Ne-A Mixtures. I. I. Glotov. *Phys. Zeits. d. Sowjetunion,* 12. 3. *pp.* 256–268, 1937. *In German.*—Measurements have been made of the ionisation coefficient α in pure Ne and in Ne-A mixtures for various values of E/p from 7·5 to 25 V/cm./mm. The results obtained for pure Ne agree within the limits of error with those of Townsend and McCallum. The addition of A up to a concentration of $10^{-3}\%$ has little effect on α, but above this value the ionisation coefficient increases very rapidly and may become many times greater than that for pure Ne. J. E. R.

***295. Scattering of Helium Canal Rays by Helium Nuclei. C. Gerthsen.** *Phys. Zeits.* 38. *pp.* 833–836, *Nov.* 1, 1937.—Apparatus is described consisting of a discharge tube, scattering chamber and counting device, in which measurements are made of the angular scattering of slow He ions by He gas. The apparatus is tested by comparing the scattering in air with theoretical predictions in which classical and wave-mechanical theories agree. The results for He show large deviations from the predictions of classical theory, particularly at large angles. Although the absolute values differ the variation of scattering with angle is in general agreement with the predictions of Mott's theory. J. E. R.

296. Magnetic Spectrograph Calculations. F. T. Rogers, Jr. *Rev. Sci. Instruments,* 8. *pp.* 432-436, *Nov.,* 1937.—A method is presented for calculating the kinetic energies of charged particles from magnetic spectrograph data. The method is of some generality in that it is valid for a magnetic field which may depart appreciably from perfect uniformity, provided only that the field focus the particles properly. It is suggested that, although the method is quite lengthy, it might be of use for calculations based on measurements of the highest precision and for calculations of ordinary precision based on data taken with a magnetic field which is not at all uniform. AUTHOR.

297. Chemical Effects of Electrical Discharge. K. R. Dixit. *Current Science,* 6. *pp.* 163–180, *Oct.,* 1937.—This paper reviews the subject up to date in order to get a physical picture of the whole process. Electrical discharge in gases is first considered, and is followed by a summary of the theories of chemical change, and a detailed description of the relevant experimental investigations which includes: the spectroscopic method, the measurement of pressure, the energies of the dissociation of the products formed by electron impact, the determination of the ratio M/N, where M is the number of molecules reacting for N ion-pairs produced, stable and metastable products, removing the back reaction by freezing out the molecules formed, and some miscellaneous experiments carried out by Miyamoto, Yajnik, Sharma and Bhatnagar. Under the theories of chemical action in electrical discharge are considered: the photochemical theory of Warburg, the static-ion theory of Lind, the ion-cluster theory of Rice, the chemical equivalence law for discharge tubes suggested by Brewer and Westhaver, and the theory of critical activation by kinetic ions suggested by Donnan. It is concluded that no single unified theory for the chemical effects in the electric discharge has yet been put forward. H. H. Ho.

298. Duration of Life of Gaseous Ions and their Chemical Activity. P. Gunther and L. Holzapfel. *Zeits. f. phys. Chem.* 38. *Abt.B.* 4. *pp.* 211–220, 1937.—Experiments are described calculated to show any influence due to variation in the life-period of gaseous ions on their activity. The reactions so examined were: formation of H_2O from $H_2 + \frac{1}{2}O$, and the decomposition of NH_3 with formation of H_2. The average duration of life of the ions varied by at least a factor of 10; but no trace of variation in chemical activity could be detected. C. A. S.

***299. Valve Circuit for Scaling Down Counting Rates. E. C. Stevenson and I. A. Getting.** *Rev. Sci. Instruments,* 8. *pp.* 414–416, *Nov.*, 1937.—A scaling circuit is described which differs from that of the Wynn-Williams type in using valves instead of thyratrons. Its short resolving time (better than 1/50,000 sec.), its stability, and its durability over extended periods of operation recommend it for accurate recording of high speed Geiger-counter discharges. AUTHORS.

***300. Atomic Hydrogen. H. G. Poole.** *Roy. Soc., Proc.* 163*A*. *pp.* 404–454, *Dec.* 7, 1937.—A new type of calorimeter is described, depending on the continuous-flow principle, of high accuracy, and with sensitivity easily variable over the range 0·1 to 1·0 cal./min. for rates of heat production 4 to 300 cal./min. Curves obtained for the output of atomic H from several discharge tubes show that very large changes of atom output with time may occur with tubes depending only on a water-on-glass or water-on-silica film for deactivation of the tube wall as catalyst for the recombination of atoms. Constant and reproducible output is obtained by the use of a metaphosphoric acid lining inside the tube. An empirical expression is found for the efficiency of the discharge tube in terms of the number of dissociated molecules received as atoms at the calorimeter per unit energy supplied to the positive column. The conditions in, and working of the discharge tube are discussed and analysed mathematically, leading to the determination of the Emeléus-Lunt-Meek efficiency η_o for the sum of two dissociative processes involving the ${}^3\Sigma^+_u$ and ${}^3\Sigma^+_g$ states of the molecule over a wide pressure range. The velocity constant for the first order, wall-catalysed recombination of atoms is found, and hence the adhesion coefficient for a water-on-phosphoric acid film. In addition, a general equation for the flow of atoms and molecules through a tube is developed. N. M. B.

See also Abstracts 3, 129, 146, 149, 151, 152, 203, 241 and
54B. Formation of Electrical Discharge in Gases. E. Flegler.
55B. D.C. Corona in Coaxial Cylindrical Fields. H. Prinz.
56B. Pressure Due to Corona in a Closed Space. A. Gemant.

CONDUCTION IN SOLIDS AND LIQUIDS.

∗**301. E.H.F. Electrostatic Voltmeter. F. E. J. Ockenden.** *Journ. Sci. Instruments,* 14. *pp.* 406–408, *Dec.,* 1937.—A description is given of the constructional features of a small electrostatic voltmeter in which self-heating errors, due to dielectric losses, have been reduced to a minimum. AUTHOR.

302. New Conception of Supraconductivity. F. London. *Nature,* 140. *pp.* 793–796, *Nov.* 6, *and pp.* 834–836, *Nov.* 13, 1937.—An account of the macroscopic theory derived by the author and H. London, which is shown to be in agreement with the three principal phenomena which characterise the supraconducting state and explains them simply on a wave-kinematic basis. A molecular model based on the theory has been published recently by Slater [see Abstract 4653 (1937).] R. W. P.

303. Magnetic Behaviour of Current-Carrying Supraconductors on Transition to Supraconducting State. K. Steiner. *Phys. Zeits.* 38. *pp.* 880–887, *Nov.* 15, 1937. *From the Reichsanstalt.*—A continuation of an earlier investigation [see Abstract 4654 (1937)] in which observations are made of the deflections of a sensitive ballistic galvanometer resulting from inductive changes in hollow cylindrical specimens of In, Sn-Cd alloy and single and polycrystalline Sn. When a current of strength I_s is already flowing in the conductor it is found that before the fully supraconducting state is reached, and the deflection due to the Meissner-Ochsenfeld effect observed, a deflection occurs having the same direction as that of the magnetic field H_s due to I_s. This magnetisation, which is not observed when no current is flowing in the conductor, increases with I_s, is of the opposite sign when the current is flowing in the reverse direction, and occurs in the opposite direction on transition from the supraconducting to the normal state. When H_s is reduced to a small fraction of its value by superimposed external fields this deflection is still independent of the resultant magnetic field, and only depends on the direction and strength of the current in the conductor. [See following Abstract.] R. W. P.

304. Magnetic Induction and Supraconductivity. J. Stark, K. Steiner and H. Schoeneck. *Phys. Zeits.* 38. *pp.* 887–891, *Nov.* 15, 1937. *From the Reichsanstalt.*—The foregoing effects [see preceding Abstract] are further studied, information now being obtained as to the variation of the galvanometer deflection with time as the specimen passes through the supraconducting state. Results similar to those of the preceding paper are obtained for two hollow cylinders of polycrystalline Sn, and there is evidence for the existence of a hysteresis effect. Subsequent experiments in which two solid cylinders of Sn were used again gave results separated by a time interval and indicating the presence of hysteresis, but no influence of the electric current could be detected. Examination of the magnetic properties of specimens of Au and W failed to disclose any appreciable change in the magnetic induction of these normal conductors at liquid He temperatures. R. W. P.

305. Electrical Conductivity of Tungsten Single Crystals at Low Temperatures in Strong Magnetic Fields. E. Justi and H. Scheffers. *Phys. Zeits.* 38. *pp.* 891–896, *Nov.* 15, 1937. *From the Reichsanstalt.*—Certain problems have arisen from the authors' previous work [see Abstract 5382 (1936)] and an attempt is made, with the aid of better equipment, to solve them. The measurements are extended to 35kG and it is found that the magnetic energy of the " free " electrons

(μH) is greater than the thermal energy (kT) and that, at the temperature of liquid He, the resistance may increase to 10^6 times the ideal resistance with no sign of saturation. The law concerning the independence of the anisotropy constant on the field strength and temperature (found previously) is verified for the higher values of field strength. The measurements are also extended to longitudinal fields which show a very small longitudinal effect in W (as opposed to other crystalline metals); an explanation of this is offered. H. J. H. S.

306. Specific Resistances of Platinum Wires and Mean Free Paths of Conduction Electrons. H. Reuter. *Ann. d. Physik,* **30.** **6.** *pp.* **494–504,** *Nov.,* **1937.**—The electrical resistances of Pt wires from 15·7–202μ in dia. have been measured over the temperature, range − 150° C. to 0° C. The results show an almost linear relationship between the specific electrical resistance and the reciprocal wire thickness. An evaluation on the basis of the Nordheim formula for the increase in specific resistance of thin wires consequent in the limitation of the path length, gives for the mean free path at 0°C, $\lambda_0 = 3{\cdot}7\mu$. An explanation of measured results from the general viewpoint of a wire surrounded by a badly conducting layer, which can arise through impurities or through the limitation of the free path by the surfaces of the wire, demands for the thickness of this layer a value dependent on the temperature. An interpretation of the observed increase of specific resistance through the limitation of path length appears to be highly probable. By calculations of this type the path length at 0° C. is found to be $\lambda_0 = 1{\cdot}62\mu$. C. J. B. C.

307. Resistance and Magnetic Susceptiblity of D_2–Charged Palladium. A. Sieverts and W. Danz. *Zeits. f. phys. Chem.* **38.** *Abt.B.* **1.** *pp.* **61–71, 1937.**—A comparative study of Pd–H_2 and Pd–D_2 alloys showed (a) greater effects of D_2 than of H_2 on the electrical resistance of Pd; (b) a similar drop in magnetic susceptibility at equi-atomic concentrations of D_2 and H_2. L. V. C.

308. Conductivity and Diffusion in the Semi-Metallic Alloys $Cu_{2-x}Se$. H. Reinhold, H. Möhring and H. Seidel. *Zeits. f. phys. Chem.* **38.** *Abt.B.* **4.** *pp.* **221–269, 1937.**—The specific conductivity of semi-metallic alloys of the composition $Cu_{1{\cdot}96}Se$, $Cu_{1{\cdot}89}Se$, $Cu_{1{\cdot}78}Se$, and $Cu_{1{\cdot}60}Se$ was determined in the temperature range + 350° to − 180°. There is a hysteresis effect at low temperatures. The thermoelectric power of the alloys coupled with Pt was determined from 0° to 350°. Above 115° the thermoelectric power of the α-phases is expressed by the equation $dE/dt = a + 2\beta(t - t_0)$, where $t_0 = 115°$. The diffusion constant is determined at different temperatures, and is abnormally high. The direction of the e.m.f. of the differential thermocouple Cu_{2-x_1} Se Cu_{2-x_2} Se and the variation of the conductivity and ionic mobility with concentration indicates electron and Cu^+ ion defect conductivity. A method is described for the determination of transport numbers of the order of 10^{-4} to 10^{-5} in the above semi-metallic alloys, using the equation $n^+ = (DaF/I)q.de/dx$. The diffusion constant in phases with non-stoichiometrical composition is about 10% greater than the coefficient of self-diffusion. The determination of conductivity, transport numbers, velocity of diffusion, and the Ludwig-Soret effect shows that the mobility of the Cu^+ ion in these alloys is unsually large. A. J. M.

309. Conductances of Standard KCl Solution. R. W. Bremner and T. G. Thompson. *Am. Chem. Soc., J.* **59.** *pp.* **2372–2374,** *Nov.,* **1937.**—The values of the specific conductances of 0·1 demal and 0·01 demal standard KCl solutions have been measured at 5, 10, 15, and 20°. An interpolation formula that will reproduce these results and the results of Jones and Bradshaw [see Abstract 3169 (1933)] at 0, 18, and 25° within 0·01% for 0·1 demal KCl solution and within 0·001% for 0·01 demal KCl solution has been proposed and the constants evaluated for these concentrations. The proposed formula, unlike that of Kohlrausch and Grotrian, predicts a point of inflection in each temperature–conductance curve. AUTHORS.

310. Conductance of Salts in H_2O–D_2O Mixtures. J. P. Chittum and V. K. La Mer. *Am. Chem. Soc., J.* 59. *pp.* 2425–2430, *Nov.*, 1937.—The equivalent conductance of approximately 0·02 *N* solutions of LiCl and KCl and potassium acetate has been measured in various H_2O–D_2O mixtures at 25·000°. A sensitive and discriminating comparison of the viscosity dependence of the conductance of the salt solutions is obtained by plotting log $\Lambda_0\eta$ *vs.* log η. The mobilities in D_2O of the Li, Na, K, Cl and acetate ions have been calculated from the present conductance data and a measurement by Longsworth of the transference number of K ion in D_2O from measurements on KCl. The transference number of Li ion appears to decrease about 2% on passing from H_2O to D_2O, the other ions being affected less. The stoichiometric dissociation constant (K') of acetic acid is obtained for pure D_2O. The origin of a difference between the values of K' calculated from conductance data and $K'_{H,D}$ defined by Korman and La Mer in H_2O–D_2O mixtures is explained. Preliminary measurements indicate that the temperature coefficient of the equivalent conductance of solutions of NaCl is larger in D_2O than in H_2O between the temperatures of 25 and 45°. AUTHORS.

311. Conductivities of Metallic Complexes in Dilute Solution. A. B. Densham. *Faraday Soc., Trans.* 33. *pp.* 1513–1521, *Dec.*, 1937.—The following new salts have been prepared: Tetra-ethyl-ammonium diammino-tetranitro-cobaltiate, tetra-pyridino-difluor-chromic diammino-tetranitro-cobaltiate, tetra-pyridino-difluor-chromic picrate. The electrical conductivities have been measured of solutions of some diammino-tetranitro-cobaltiates in methyl alcohol and acetone, and of some tetra-pyridino-difluor-chromic salts in water, methyl alcohol, ethyl alcohol and acetone. Values have been obtained for $l[Co(NH_3)_2(NO_2)_4]$ in acetone and methyl alcohol, and for $l[CrPy_4F_2]$ in water, methyl alcohol, ethyl alcohol and acetone. The relation between Λ_c and $\sqrt{C}$ is in fairly close agreement with Onsager's equation for all the salts investigated. The effect of water additions is in agreement with that calculated from the changes in concentration and viscosity. The value of $l_0 \times \eta$ is constant to within 5% for the ion $[Co(NH_3)_2(NO_2)_4]^-$ in acetone and methyl alcohol, and for the ion $[CrPy_4F_2]^+$ in methyl alcohol, ethyl alcohol and acetone, but is 25% lower for the latter ion in water. AUTHOR.

312. H.F. Conductivity of Colloidal Electrolytes. G. Schmid and T. R. Aalts. *Zeits. f. Elektrochem.* 43. *pp.* 907–914, *Dec.*, 1937.—Previous measurements with $\lambda = 3\cdot6$ m. on alkali- and alkaline earth caesinates [see Abstract 5665 (1936)], are extended by determinations with $\lambda = 12, 20, 50, 100$ m. The plot of log λ against percentage increase in conductivity due to h.f. gives a smooth curve, approximately a straight line. Caesinates of Mg, Ca, Sr, Ba give very similar values for the increase, but greater than that for Na-, which exceeds that of K caesinate. Results obtained are held to be a definite confirmation of the theory that electrostatically the caesinates are strong electrolytes. This is confirmed both by the differences in dispersion curves for the Gp. I- and Gp. II-caesinates, on account of different kation valencies; and by the smaller steps for equivalent kations, attributable to differences in mobility. D. R. H.

See also Abstracts **24**, **287**, **356** and
66B. H.F. Electrodynamic Ammeter. H. M. Turner and P. C. Michel
71B. Oil Immersed Generating Voltmeter. H. A. Thomas.

DIELECTRICS AND CAPACITANCE.

313. Dielectric Constant of a Space Containing Electrons. S. P. Prasad and M. V. Verma. *Zeits. f. Physik*, 107. 7–8. *pp.* 441–448, 1937.—Continuing previous work [see Abstract 2842 (1936)], the influences of transit time and h.f. voltage are investigated. The results of the whole investigation are summarised as follows:—(1) The d.c. ϵ of a space containing electrons decreases with (*a*) increase of wave-length of h.f. voltage, (*b*) increasing electron concentration and (*c*) increased transit time of electrons in the condenser. In all cases the d.c. tends to a limiting value. The relation $\epsilon = 1 - 4\pi Ne^2\lambda^2At/[4\pi^2v^2m + \alpha 4\pi Ne^2\lambda^2At]$, where A and α are constants, is in better agreement with the observations than the Larmor formula. (2) The results show that the decrease of dielectric constant in no case becomes greater than unity. (3) The decrease of d.c. is related parabolically to the magnitude of the h.f. voltage. This has not before been observed. A. M. T.

314. Dielectric Constants of Solutions of Amphoteric Electrolytes. Part III. H. Linhart. *Zeits. f. phys. Chem.* 38. *Abt.B.* 1. *pp.* 23–45, 1937.—Extending the work of Blüh and Kroczek [see Abstract 448 (1935)], the author has carried out investigations on simple amino-acids using frequencies corresponding to λλ 52–90 cm., the capacitance-measuring circuit being inductively coupled to a variable Lecher-wire oscillator. Above λ 100 cm., the change in dielectric constant, $\Delta\epsilon$ (solution-solvent), is a linear function of concentration and is independent of λ; below this wave-length, $\Delta\epsilon$ is less, settling down to a lower level at about λ 75 cm. (glycocoll, valine, glycyl-glycine). At these values of λ, $\Delta\epsilon$ no longer varies linearly with concentration, implying the presence of ionic aggregates (probably with varying hydration) of varying size. With leucyl-glycyl-glycine, the diminution in $\Delta\epsilon$ is progressive with diminishing λ. The results are considered in relation to the factors affecting the relaxation time of the ions, particularly damping forces and the influence thereon of long or short side-chains. L. V. C.

315. Dielectric Polarisation and Viscosity of Liquid Chloronitrobenzene. A. Jagielski. *Acad. Polonaise Sci. et Lettres, Bull.* 6–8*A*. *pp.* 312–319, *June–Oct.*, 1937. *In German.*—By introducing previously determined values of densities and dielectric constants [see Abstract 1345 (1937)] into formulæ recently given by Wyman [see Abstract 4843 (1936)] and Onsager [see Abstract 4842 (1936)] values are deduced for the dipole moments of the *p*-, *m*- and *o*-isomers of liquid chloronitrobenzene. These are respectively $2\cdot80 \times 10^{-18}$, $4\cdot26 \times 10^{-18}$ and $6\cdot17 \times 10^{-18}$ e.s.u.; the first of these values is equal to and the other two are greater than values found by measurements of solutions. It is conjectured that the high dipole moments found for *m*- and *o*-chloronitrobenzene are indicative of molecular association, and that the lower value found for the *p*-isomer indicates that it is a non-associating liquid for which Wyman's formula gives the true value of the dipole moment.

This conjecture is confirmed by application of Andrade's theory of viscosity of non-associating fluids to measurements of the variation of viscosity of the three isomers with temperature. J. E. K.

316. Dielectric Properties of Acetylenic Compounds. Part IX. H. L. Goebel and H. H. Wenzke. *Am. Chem. Soc., J.* 59. *pp.* 2301–2302, *Nov.*, 1937.—Electric moments have been determined for a number of aldehydes: benzaldehyde, butylpropiolyl-, amylpropiolyl- and phenylpropiolyl-; and several ketones, acetophenone, butylacetylacetylene, amylacetylacetylene and phenylacetylacetylene. The moments of the acetylenic aldehydes and ketones are considerably higher than those of the alkyl and phenyl derivatives. These higher moments have been explained by the contribution of highly polar structures in resonance with the classical form. [For Part VIII see Abstract 4169 (1937).] AUTHORS.

317. Dielectric Measurements on Hydrophilic Colloids. Part II. P. J. Denekamp and H. R. Kruyt. *Kolloid Zeits.* 81. *pp.* 151–164, *Nov.*, 1937.—This paper continues previous work [see Abstract 5436 (1937)] and includes a full description of a bridge method (1150 kc./s., $\lambda = 261$ m.) for the measurement of the dielectric constants of liquids which possess a conductivity up to 10^{-4} ohm^{-1} cm^{-1}. The method affords an accuracy of $\sim 0{\cdot}2\%$. The paper is illustrated by 11 diagrams. H. H. Ho.

318. Dipole Moment of a Diatomic Molecule in Non-Polar Solvent. F. Fairbrother. *Faraday Soc., Trans.* 33. *pp.* 1507–1513, *Dec.*, 1937.—The increase in dipole moment which several diatomic molecules exhibit when transferred from the gaseous state to solution has been attributed to an increase in the ionic character of the valence bond [see Abstract 3829 (1936)]. In this paper the secular equation for a bond of mixed type is set up and it is shown that the increase in moment of the molecule can be accounted for by the lowering of the energy levels of the ionic state relative to the covalent state by the solvation effect of the medium. AUTHOR.

319. Dielectric Constant Measurements on Solids. D. Doborzyński. *Acad. Polonaise Sci. et Lettres, Bull.* 6–8*A*. *pp.* 320–349, *June–Oct.*, 1937. *In German.*—The dielectric constants of fused and crystalline quartz are determined from measurements of the rotation of an ellipsoid of the material which is suspended and polarised in an electric field. The dielectric constant (k) of fused quartz is found to be 3·92, and is independent of frequency over the range $0{\cdot}1 \times 10^6$ to $5 \times 10^6\sim$. For crystalline quartz when cut perpendicular to the optical axis, k is 4·55 at $50\sim$ and 4·41 at $5 \times 10^6\sim$; when cut parallel to the optical axis, the values of k are then 4·66 and 4·58. Over the frequency range of $0{\cdot}1 \times 10^6$ to $5 \times 10^6\sim$, the dielectric constant-frequency curves show pronounced irregularities at certain frequencies due to the piezoelectric effect. E. R.

See also Abstracts 10, 70, 244, 288, 348, 367 and

73B. Direct Reading Capacitance Meter. H. Bumann and J. Pfaffenberger.

ELECTROCHEMISTRY.

***320. Fundamental Properties of the Ideal Cell. E. Lange and K. Nagel.** *Zeits. f. phys. Chem.* 181. *Abt.A.* 1. *pp.* 1–54, 1937.—It is assumed that at least one ion is freely mobile within all phases, that the transfer mobility at interfaces is practically unlimited in the case of the potential-determining ion, and completely limited in the case of the other ion. Two idealised types of cell are considered from the standpoints of

(1) phases; (2) potentials; (3) current flux-oxygen exchange; (4) reactions; (5) reversible heats. In actual cells there is always more or less deviation from the ideal, the solid phases being replaced by aqueous solutions of lower conductivity. In practice H_2- and O_2-overvoltages are important. The nearness with which ideal cells may be approached, is discussed theoretically. With normal elements these overvoltages must be high enough to exclude completely H_2 and O_2 generation, even at low current densities (*e.g.*, the Cd cell). With galvanic elements generation is practically prevented at rest and during discharge, but not otherwise, and in practice reversibility is impossible. The Pb and Ni accumulators are discussed theoretically in detail. D. R. H.

321. Mobilities of Ions in Liquid Hydrocarbons and their Relation to the Coefficient of Viscosity. M. I. Adamczewski. *Ann. de. Physique*, 8. *pp.* 309–359, *Oct.*, 1937.—The author has employed three different methods of measuring the mobilities of ions produced by X-rays in five saturated hydrocarbons, C_5H_{12}, C_6H_{14}, C_7H_{16}, C_8H_{18}, and C_9H_{20}. The principal measurements were made by Langevin's method with certain modifications introduced and described by the author. The measurements show in each of the five liquids the existence of three kinds of ions, two positive of which the ratio of the mobilities is 3 : 1 and one negative of intermediate mobility. The results give values for the mobilities of the ions ranging between $0{\cdot}78 \times 10^{-4}$ cm².*/*sec. volt and $12{\cdot}01 \times 10^{-4}$ cm².*/*sec. volt; they diminish regularly as the viscosity of the medium increases. The analysis of the variations of the mobilities u as a function of the coefficient of viscosity η leads to an empirical formula $u = A\eta^{-3/2}$ where A is a constant for each ion. The extrapolation of this formula for the liquids with large viscosity yield values which are in good agreement with the experimental results of Bialobrzeski, Szivessy and of Schäffer. [See also Abstract 464 (1935).] R. L.

322. Electrolytic Overvoltage. M. Lemarchands and W. Juda. *Comptes Rendus*, 205. *pp.* 730–732, *Oct.* 26, 1937.—Overvoltage depends on the fact that in electrolysis the electrodes attract the ions of contrary sign so much the more forcibly the nearer they are to the electrode; consequently the more distant ions will only arrive more slowly causing diminution in their concentration, and a lowering of the p.d. near the electrode. The amount of this lowering as compared with the p.d. for a reversible electrode is the overvoltage. This explanation is shown to be in conformity with the observed phenomena of overvoltage. C. A. S.

323. Electrochemical Investigations of Solid Metallic Alloys. A. Ölander. *Zeits. f. Metallkunde*, 29. *pp.* 361–366, *Nov.*, 1937.—The paper is a comprehensive review of the measurements of electrochemical potentials and the calculation of thermodynamic data. The results are critically examined and discussed. F. J. B.

324. E.M.F.s between Glass and Salts in Melts. B. v. Lengyel and A. Sammt. *Zeits. f. phys. Chem.* 181. *Abt.A.* 1. *pp.* 55–69, 1937.—The e.m.f.s between glasses and $PbCl_2$ melts containing alkali-metal ions are measured. Na-glass behaves as an Na-electrode relative to Na^+-ions of concentrations above 10^{-4} mol./100 gm. $PbCl_2$. With pure K-glass against melts containing K^+-ions the e.m.f. is again a linear function of the log of the concentration, but the e.m.f. is smaller than that calculated by the Nernst theory. Results with Li^+-ions and Na-glasses are in good agreement with theory for small concentrations, but at higher concentrations the e.m.f. is higher than that calculated. Investigation of mixed systems shows that the e.m.f. is always determined by the ion of smaller atomic weight. For the ions investigated there is a parallelism between ionic mobility and e.m.f. set up. L. A. W.

325. Theory of the Glass Electrode. Part I. B. P. Nicolsky. *Acta Physicochimica*, 7. 4. *pp.* 597–610, 1937. *In English.*—In this paper is given the mechanism of the glass electrode function, according to which a thin (but polymolecular) layer of glass at the surface enters into equilibrium with a solution. During the establishment of this equilibrium an exchange of Na- and H-ions takes place in the glass surface layer. The equilibrium of this exchange is determined by the constant of equilibrium (the constant of ion exchange) which characterises the difference in the strength of Na- and H-ion linkage in the glass as compared with those in the solution. On the basis of this mechanism is developed a thermodynamic theory of the glass electrode, leading to the formula $E = E^\circ + (RT/F) \ln (a_{H^+} + Ka_{Na^+})$, in which E is the e.m.f. of the glass electrode cell, a_{H^+} and a_{Na^+} are the activities of H- and Na-ions in solution and K is the constant of H- and Na-ion exchange. This equation correctly expresses the basic properties of the glass electrode as to quality. The quantitative check of this theory will be given in the next papers. AUTHOR.

326. Asymmetric Potential of the Glass Electrode. H. Yoshimura. *Chem. Soc., Japan, Bull.* 12. *pp.* 443–452, *Oct.*, 1937.—A theoretical discussion. [See Abstract 5086 (1937).] D. R. H.

327. Temperature Coefficient of the Standard Silver Electrode. Entropy of Silver Ion. J. J. Lingane and W. D. Larson. *Am. Chem. Soc., J.* 59. *pp.* 2271–2273, *Nov.*, 1937.—The temperature coefficient of the Ag electrode was determined by measuring the temperature coefficients of cells of the type Pt/quinhydrone(s), $HClO_4(C_1)/HClO_4(C_1)$, $AgNO_3(C_2)$/Ag, in which C_1 was much larger than C_2. The temperature coefficient of the standard electrode e.m.f. of Ag, *i.e.*, the temperature coefficient of the cell Ag/Ag^+ $(a = 1)$ ‖ H^+ $(a = 1)/H_2$ (1 atm.), is $+0{\cdot}967 \pm 0{\cdot}004$ mV $deg.^{-1}$ at 25°. The standard entropy of the Ag ion computed from this temperature coefficient is 16·7 $cal.deg.^{-1}mol.^{-1}$ at 25°. AUTHORS.

328. Molal Ferric–Ferrous Electrode Potential. W. C. Schumb, M. S. Sherrill and S. B. Sweetser. *Am. Chem. Soc., J.* 59. *pp.* 2360–2365, *Nov.*, 1937.—The molal ferric–ferrous electrode potential has been obtained from e.m.f. measurements in $HClO_4$ solution of cells of the type described in the introduction. The value found is − 0·7701 V. The e.m.f. data have been corrected for hydrolysis of ferric iron and plotted in such a way that errors from liquid junction potentials and changing activity coefficients are removed by extrapolation. A table of values of the formal ferric–ferrous electrode potential of $Fe(ClO_4)_3$–$Fe(ClO_4)_2$ mixtures in $HClO_4$ solution from an ionic strength of 0·1 to 1·0 has been prepared. For the ionic strength range 0·5 to 1·0, the value is − 0·741 W. A new method for the determination of free acid in the presence of ferrous and ferric iron is described. AUTHORS.

329. Electrode Polarisation. Part I. Accurate Measurement of Potential of Polarised Electrode. A. Hickling. *Faraday Soc., Trans.* 33. *pp.* 1540–1546, *Dec.*, 1937.—A new method of measuring the potentials of working electrodes is described, by means of which results accurate to 0·01 V may be obtained free from resistance error. The method is applicable to electrodes the potentials of which decay rapidly, and may be used for studying the rate of fall of potential in such cases. AUTHOR.

330. Strength of Strong Mineral Acids. H. v. Halban and M. Seiler. *Zeits. f. phys. Chem.* 181. *Abt.A.* 1. *pp.* 70–78, 1937.—Photoelectric extinction measurements are made upon solutions of α-dinitrophenol with additions of alkali perchlorates, chlorides and nitrates and of the corresponding acids in concentrations between 5×10^{-3} and 10^{-2}. It is found that the relative effects of the salts on the dissociation constant of the indicator are independent of the kation. In this respect the results obtained with the acids are identical with those for the salts, assuming that HCl and HNO_3 are completely dissociated like $HClO_4$. The accuracy of the measurements indicates that the undissociated part in the solutions of HCl and HNO_3 cannot exceed 0·01%. These results are in agreement with previous estimates of the strengths of these acids but not with the calculations of Redlich and Rosenfeld from Raman effect data for HNO_3.
L. A. W.

ELECTRONS, NEUTRONS, POSITRONS AND PROTONS.

331. Symmetry between Particles and Anti-Particles. G. Racah. *N. Cimento,* 14. *pp.* 322–328, *July,* 1937.—It is shown that the relativistic wave equation contains a factor which enters into the symmetry of the wave functions upon reflection and which may have four different values. It is shown that, in order that the theory may be completely symmetric between particles and "holes" (*e.g.,* between negative and positive electrons) only one of these values is admissible. The importance of this for the theory of β-emission is pointed out. In the theory proposed by Majorana [see Abstract 4685 (1937)] there is not only symmetry between particles and holes, but they are physically indistinguishable. It is shown that, in principle, an experiment is possible which would decide for or against Majorana's theory. If an attempt is made to generalise Majorana's theory so as to make it apply to the neutron, difficulties are met with because of the magnetic moment of the neutron and also because of the non-occurrence of the negative proton. R. P.

332. Ratio of Masses of Fundamental Particles. H. T. Flint. *Phys. Soc., Proc.* 50. *pp.* 90–95, *Jan.* 1, 1938.—A discussion of the nature of the equations of the quantum theory, based upon the theory of relativity, having indicated that difficulties of a fundamental character will arise when dimensions less than the electron-radius are concerned, it is pointed out that the idea that such dimensions are not observable must be included in a geometrical description in physics. The electron-radius is thus the minimum length discovered in measurements relating to the interaction of particles. But the principle of minimum proper time applied to the track of a heavy particle M_0 shows that the particle is in effect a time scale whose finest division is h/M_0c^2. In the theory of relativity the conception of a minimum length e^2/m_0c^2 becomes equivalent to the conception of a minimum interval of proper time e^2/m_0c^3. The argument shows that these two intervals are of the same order of magnitude and leads to a simple relation between the mass ratio of the proton and electron and the fine-structure constant. [See also Abstract 2017 (1936).] AUTHOR.

333. Angular Distribution of Pairs Produced in Pb by Penetrating or Hard γ-Radiation. H. Adam. *Phys. Zeits.* 38. *pp.* 824–831, *Nov.* 1, 1937.—Using coincidence counters, examination is made of the angular distribution of positron-electron pairs produced in Pb by penetrating radiation or by γ-rays from ThC″. For the C and D rays of penetrating radiation, greater angles than 30° between positron and electron were seldom observed. In agreement with other workers the angular separation for the pairs formed by the $2\cdot62$ MV γ-ray from ThC″ showed a frequency maximum at about 30°. In a note which follows, **G. Burkhardt** (*pp.* 831–833) discusses the above results in terms of the theory of Bethe and Heitler. F. C. C.

334. Angular Distribution of Protons Projected by Fast Neutrons. P. I. Dee and C. W. Gilbert. *Roy. Soc., Proc.* 163A. *pp.* 265–281, *Nov.* 19, 1937.—Expansion chamber photographs are obtained of about 2000 tracks of protons recoiling from the impacts of neutrons of $2\cdot4 \times 10^6$ eV energy. By measurement of the ranges and angles of projection of the protons relative to the direction of the incident neutrons the angular distribution function for the collision is determined. The function obtained is $N = N_0\{1 - \lambda(1 - \cos 2\theta)\}$ where N = the number of protons projected per unit solid angle in a direction making an angle θ with the direction of the incident neutrons. The value of λ obtained is $0\cdot1 \pm 0\cdot1$ and the distribution of scattered protons is therefore almost isotropic about the centre of gravity of the colliding particles. This result is at variance with that obtained by a number of experimenters who have observed angular distributions showing wide departures from isotropy. The result obtained lends support to the view that the force of interaction between neutron and proton is very small when the relative separation of the particles exceeds 3×10^{-13} cm. AUTHORS.

335. Range and Angle of Projection for Protons in Photo-Disintegration of Deuterium. J. Chadwick, N. Feather and E. Bretscher. *Roy. Soc., Proc.* 163*A*. *pp.* 366–375, *Dec.* 7, 1937.—Measurements of range and angle have been made on the tracks of 62 protons produced in an expansion chamber containing a deuterium-rich gas and irradiated by the γ-rays from a radiothorium source. These measurements have been analysed in detail and critically discussed. It is concluded that the determinations of range indicate a binding energy of $2\cdot25 \pm 0\cdot05 \times 10^6$ eV for the deuteron and that the angular distribution implies a considerable preponderance of the photoelectric over the photomagnetic type of disintegration with the radiation employed ($h\nu = 2\cdot62 \times 10^6$ eV). This binding energy gives a value of $1\cdot0090$ for the mass of the neutron. AUTHORS.

336. Nature of Interaction between Neutron and Proton from Scattering Experiments. H. S. W. Massey and R. A. Buckingham. *Roy. Soc., Proc.* 163*A*. *pp.* 281–297, *Nov.* 19, 1937.—The possibility of deciding the nature of the force between a neutron and proton from experiments on the angular distribution of protons projected by neutron collision is considered in detail. Calculations have been carried out for both ordinary and exchange types of interaction using four different functional forms—the " spherical well," the " Gauss " function, the spherical well plus inverse fifth power " tail," and the exponential function. Account is taken of the binding energies of ${}_1H^2$, ${}_1H^3$, ${}_2He^3$ and ${}_2He^4$ to limit the possibilities, and it is found that it should be possible to distinguish between ordinary and exchange forces from experiments using neutrons with energies as low as $2\cdot2$ eMV, provided the form of the interaction does not resemble the spherical well too closely. Tables and figures are provided which can be used to interpret experimental results. The available experimental information is not definite enough for any reliable conclusion to be drawn. AUTHORS.

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337. Scattering and Absorption Cross-Section of Neutrons in Cobalt. N. E. Bradbury, F. Bloch, H. Tatel and P. A. Ross. *Phys. Rev.* 52. *pp.* 1023–1026, *Nov.* 15, 1937.—A low voltage neutron source is described which employs the deuteron-deuteron reaction with a continuously renewable target of ND_4Cl. Such a target is formed by subliming ND_4Cl on a metal target cooled with solid CO_2. Neutrons so obtained have been used to study the absorption and scattering cross-sections of Co. The sum of the absorption and scattering cross-sections for Co is $26 \cdot 1 \pm 2 \cdot 6 \times 10^{-24}$ cm.^{2}, and the scattering cross-section alone, is for C neutrons $5 \cdot 6 \pm 1 \cdot 8 \times 10^{-24}$ cm.^{2}, and for D neutrons $3 \cdot 7 \pm 1 \cdot 8 \times 10^{-24}$ cm^2. The anomalously large scattering cross-sections of Fe and Ni are thus seen to be independent of their ferromagnetism since the Co cross-section is essentially normal in magnitude. AUTHORS.

338. Energy Losses of Fast Electrons. L. J. Laslett and D. G. Hurst. *Phys. Rev.* 52. *pp.* 1035–1039, *Nov.* 15, 1937.—The energy losses experienced by electrons of energies $1 \cdot 5 - 4 \cdot 5$ eMV in traversing thin laminae of C and Pb were investigated with a H_2-filled cloud chamber, activated Cl being used as a source of electrons. The experimental average energy loss per gm./cm.^{2} of Pb was markedly greater than that predicted by theory, and this difference could not be explained on the basis of the obliquity of electron paths in the absorber. The absolute probability of large energy losses was found to be very considerably greater than that expected by theory. N. M. B.

339. Diffraction of β-Rays. S. C. Curran. *Phil. Mag.* 24. *pp.* 953–964, *Nov.*, 1937. *Supplement.*—The diffraction of β-rays by thin films is examined, using the β-rays emitted by RaE. Taking the mean energy of the rays as 3×10^5 V, good agreement is obtained with theory when measurements are made on the diffraction patterns given by Al and Au. No pattern was obtained with a celluloid film. F. C. C.

340. Theory of Elastic Scattering of a Beam of Particles by Atoms. K. C. Kar, M. Ghosh and K. K. Mukherjee. *Phil. Mag.* 24. 964–971, *Nov.*, 1937. *Supplement.*—A general theory of elastic scattering of a beam of particles by atoms is developed. The formula derived is similar to, although not identical with, that given by Faxen and Holtzmark, but it is obtained by considering the higher Born approximations. [See following Abstract.] F. C. C.

341. Elastic Scattering by Hydrogen and Helium. K. C. Kar. *Phil. Mag.* 24. *pp.* 971–981, *Nov.*, 1937. *Supplement.*—The method developed by Kar, Ghosh and Mukerjee [see preceding Abstract] is applied to calculate the angular variation of the scattering of 700 V and 25 V electrons in He and in H_2. Comparison with the experimental results of Hughes, McMillen and Webb gives moderately good agreement at all angles. This contrasts with previous formulæ which fail at low angles for high-velocity electrons and at all angles for low-velocity electrons. The present formula is not in quite perfect agreement with experiment at small angles nor does it account for the minimum observed experimentally in the intensity-angle curve for He at low velocities. F. C. C.

***342. Electron Microscopes and Telescopes. G. Gallarati and G. Madia.** *Televisione*, 1. *pp.* 59–71, *Oct.*, 1937.—The principles of electron optics in application to electric and magnetic lenses are explained and some electron microscopes and telescopes are described, giving some of their main applications. R. P.

343. Distortion in a Weak Magnetic Electron Lens. J. Gratsiatos. *Zeits. f. Physik,* 107. 5–6. *pp.* 382–386, 1937.—Equations deduced by Scherzer [see Abstract 4366 (1936)] are applied to the case of a short weak magnetic lens, in first approximation. R. P.

***344. Electron-Optical Imagery of Gas Beams by the Dark Field Method. H. Boersch.** *Zeits. f. Physik,* 107. 7–8. *pp.* 493–496, 1937.—An electron optical system is described which permits measurements to be made of the diffuse scattering of gas streams emerging from a jet. The gas (CCl_4 vapour) enters the vacuum from a jet 0·3 mm. in dia. at pressures up to 100 mm. Hg. and is then directed on to a Cu cylinder cooled by liquid air. The dimensions of the system are such that the vacuum is maintained in the essential portions of the tube. A 30 kV beam of electrons impinges on the gas stream immediately it has left the jet. A magnetic lens is used for focussing and the dark field method suggested by the author [see Abstract 4364 (1936)] is used. Photographs are given of the spreading of the gas stream *in vacuo* for different initial pressures. H. J. H. S.

345. Temperature of Electrons in a Magnetic Field. A. Slutzkin. *Phys. Zeits. d. Sowjetunion,* 12. 2. *pp.* 215–232, 1937. *In German.*—The effect of a magnetic field on a gaseous discharge is investigated for the case when the field is parallel or at right angles to the discharge tube axis and to the electric field. When the magnetic and electric fields are parallel, there is only a relatively small effect on the discharge but when the fields are at right angles there is a marked effect which may be described as an apparent increase in pressure in the discharge tube. An account is given of a series of measurements with the aid of a probe on l.v. discharges (36 V) with anode currents of 100 mA and with fields of 80-250 Oe. It is found that, in a direction at right angles to the magnetic field, a rapid decrease in electron temperature occurs with increasing distance from the centre of the electron beam. An approximate value of the temperature gradient in this direction is calculated. [See also Abstract 5158 (1935).] H. J. H. S.

***346. Electron Diffraction Demonstration Apparatus. J. J. Trillat.** *Elect. Communication,* 16. *pp.* 103–107, *Oct.,* 1937.—A description is given of apparatus specially designed for the Paris International Exhibition of 1937 in which it was desired that the diffraction of electrons could be shown to the public in such a way that a minimum of adjustment was necessary, that the public could operate the apparatus and that the possibilities of incorrect operation could be avoided. These conditions are fulfilled in a permanently evacuated tube which is described in detail. The diffraction of a 45kV electron beam by W foil 0·04 to 0·05 μ thick could readily be made visible to an audience. H. J. H. S.

***347. Neutron Tube without Pumping Device. F. M. Penning and J. H. A. Moubis.** *Physica,* 4. *pp.* 1190–1199, *Dec.,* 1937. *In German.*—A discharge tube is described for the excitation of neutrons by bombardment of a (Zr-D)-target with D_2-ions. By means of a magnetic field it is possible to maintain the glow discharge, used as ion-source, at a pressure of only 10^{-3} mm. (and a p.d. of a few kV), so that no pumping is needed between the ion source and the part of the tube where the ions are accelerated. The number of neutrons produced by this tube was in a certain case equivalent to that of about 10 mC Ra-Be. By using a watercooled target it should be possible to increase this number considerably. AUTHORS

See also Abstracts 146, 179, 287, 295, 379, 382.

ELECTROSTATICS.

348. Distribution of Electricity on Two Cylinders. E. P. Adams. *Am. Phil. Soc., Proc.* 78. 1. *pp.* 191–243, 1937.—The distribution of electricity on two infinitely long conducting strips with their edges parallel and lying in the same plane, and on two infinitely long strips in parallel planes at a finite distance apart when there is symmetry about the plane perpendicular to and bisecting them, is determined in this paper. The strips may be of equal or unequal breadths. They may be insulated with any assigned charges on unit lengths and their difference of potential is determined, or they may be at the same potential and the ratio in which a given charge divides between them is found. For strips of equal breadths the force between unit lengths is found when the strips have any charges. The distribution of electricity on the strips when they are placed in a uniform electric field is also determined. If the two strips have equal and opposite charges the equipotential surfaces will consist of two systems of cylinders, one system surrounding each of the strips. If any pair of these cylinders is taken, one from each of the two systems, they may be considered as conducting cylinders and the distribution of electricity is found on them when they are charged in any manner. There is one system of pairs of cylinders that is of special interest as it is a fair approximation to the pairs of cylinders obtained by dividing a circular cylinder by any plane parallel to the axis and separating the two portions a short distance. The force between two such equal cylinders when they have any charges is found. Finally it is shown how the distribution of electricity on any such pair of cylinders when placed in a uniform electric field may be determined. AUTHOR.

349. Volta Effect in Vacuum. E. Perucca. *N. Cimento,* 14. *pp.* 310–313, *July,* 1937.—The conclusions drawn by Krüger and Schulz from experiments [see Abstract 3344 (1936)], that the Volta effect vanishes *in vacuo,* are disputed. A probable cause of error is indicated and an experimental procedure for eliminating this error is proposed.

See also Abstracts 128, 146.

GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS.

See Abstracts 250, 303, 304, 305.

MAGNETISM AND ELECTROMAGNETISM.

350. Magnetic Moment and Molecular Field of Ferromagnetics. L. Néel. *Ann. de Physique,* 8. *pp.* 237–308, *Oct.,* 1937.—A review is given of the subject in four sections. In sections (1) and (2) the general theory of the anomalous volume characteristics of ferromagnetics is developed in which it is shown that the anomaly is the sum of two terms, one varying with temperature and the other independent of it. The theory enables a formula to be obtained which is in agreement with the experimental results of Chevenard. The theory is applied to considerations of the energy of interaction of neighbouring atoms in a lattice as a function of distance and with the aid of experimental data the 2nd and 3rd derivatives are deduced and examples are given of their application. In section

(3) the effect of temperature and of oscillations on the energy of interaction is discussed and it is shown that the molecular field is a linear function of temperature. The significance of the Curie constants is also discussed. In section (4) an attempt is made to explain the differences between the ferromagnetic and paramagnetic moments on the assumption that at saturation magnetisation a complete orientation is not obtained; the existence of discontinuities which obey statistical laws is also explained and it is shown how the magnetic moments of ferromagnetic metals and of their alloys may be deduced and how the complicated curves of the atomic moments of the ferro-nickels and ferro-cobalts as a function of concentration may be interpreted. H. J. H. S.

351. Saturation Magnetisation and Approximation Law for Iron. W. Steinhaus, A. Kussmann and E. Schoen. *Phys. Zeits.* 38. *pp.* 777–785, *Oct.* 15, 1937. *From the Reichsanstalt.*—The increasing importance of a study of ferromagnetic bodies in very strong magnetic fields is emphasised. A description is given of a yoke isthmus method (absolute method) and a differential method of high accuracy for examining the path of the magnetisation curves in the region of saturation in very pure polycrystalline Fe of different types, commercial irons and Fe alloys. The saturation intensity and the effect on it of additions of alloys, cold work and thermal treatment are also examined. It is found that the form of the approximation law in different field strength regions is different and that, at about 2% below saturation, the intensity I is related to H by the expression $I = 1 - \text{const.}/H^2$ but at higher intensities by the expression $I = 1 - \text{const.}/H$. Assuming the validity of the latter formula, it is shown that, for $H = \infty$ for a very pure Fe (density 7·878) at room-temperature, the specific saturation is $\sigma_\infty = 217{\cdot}98 \pm 0{\cdot}01$. [See also Abstract 44 (1936).] H. J. H. S.

• **352. Susceptibility in Nickel. D. Kirkham.** *Phys. Rev.* 52. *pp.* 1162–1167, *Dec.* 1, 1937.—This research is a sequel to an investigation, previously reported, of the variation of Young's modulus and internal friction with magnetisation and temperature in a specimen of annealed, polycrystalline Mond Ni. The specimens used in both researches were cut from the same bar of material and annealed in the same manner. Complete data are given which show the variation of the initial susceptibility with temperature and that of the magnetostriction and reversible susceptibility with temperature, magnetisation and magnetising field between 21° C. and the Curie temperature. The course of the initial susceptibility *vs.* temperature curve indicates a transition of the direction of intrinsic magnetisation of the elementary domains in Ni from 111 to 100 at about 200° C. Further discussion of the results, in accordance with the domain theory of ferromagnetism, will appear in a subsequent paper by W. F. Brown, Jr. [See also Abstract 4197 (1937).] AUTHOR.

353. Diamagnetic Susceptibilities of Complex Ions. S. R. Rao and S. Sriraman. *Phil. Mag.* 24. *pp.* 1025–1041, *Dec.*, 1937.—The diamagnetic susceptibilities of some formates and acetates, nitrites and nitrates, iodates and selenites, have been determined in the state of solid and in solutions in water. Formates and acetates do not show any change of susceptibility when dissolved in water. Experiments with iodic acid and iodates showed that the specific diamagnetic susceptibility was greater in the solid state than in the state of solution. In the light of Raman effect data it looks most likely that these changes should be due to dissociation of iodic acid and iodate molecules, but the matter seems to

require further investigation. Nitrates show very small changes in susceptibility when dissolved in water because of the stable structure of the nitrate ion as revealed by X-ray studies. Nitrites show a larger increase on dissolving in water than nitrates. Magnetic data support the view that the N in the nitrite ion is trivalent. In the case of selenites the diamagnetic susceptibility increased when they were dissolved in water. These results support Venkateswaran's inference from Raman effect investigations that in the solid selenious acid Se is hexavalent and in aqueous solutions it becomes tetravalent. Attention is drawn to the necessity of studying salts in aqueous solutions before definite inferences could be drawn regarding the susceptibilities of the ions concerned.
AUTHORS.

354. Magnetic Field of a Symmetrical Bundle of Parallel Wires Carrying Equal Currents. C. G. Dunn and G. L. Clark. *Phys. Rev.* 52. *pp.* 1167–1169, *Dec.* 1, 1937.—The radial and circumferential components of the magnetic field outside and inside a bundle of parallel current filaments equally spaced on an infinitely long cylinder are derived in convergent series form. The assumption usually made that the mean circumferential component is a sufficiently good approximation to the actual field at radii of interest is justified by calculation at 12 mm. radius from the axis of a bundle containing 36 wires, 6 at 3 mm. radius, 12 at 6 mm., 18 at 9 mm. The maximum deviation of the circumferential field from its mean value is here found to be less than 0·5%. A quickly applied primary winding of 36 turns for ring specimens is described. It consists of a central bundle, flat end connecting blocks and external cage. The region of good circular field lies between radii of 12 mm. and 60 mm., and is 70 cm. in axial length. [See following Abstract.] AUTHORS.

355. X-Ray and Magnetic Analyses of Deformed Silicon Steel Rings. G. L. Clark and C. G. Dunn. *Phys. Rev.* 52. *pp.* 1170–1178, *Dec.* 1, 1937.—Flat rings cut from sheet silicon steel by grinding and etching, so as best to preserve the properties of uncut sheet, were clamped between dies that bent them to fit more or less closely over a toroidal plunger and allowed, under these conditions, testing of circumferential magnetisation and taking of X-ray diffraction patterns (Laue type) at one point on the most deformed circle. Slight deformation temporarily shifts and elongates the Laue spots and depresses the magnetisation curve. More severe deformation permanently displaces some Laue spots, although the crystals in their new orientations are not permanently strained. The magnetisation curve is permanently depressed, and it is suggested that this is due to changes at grain boundaries not recorded by the X-ray method. Very severe deformation leaves some crystals strained, as shown by X-rays, and the permanent changes in magnetic properties are nearly as great as the temporary changes. The changes in shape of Laue spots in coarse-grained rings agrees at all stages with bending of strained crystals about axes lying in the original plane of the sheet. Specimens cut from partly annealed sheets that had previously been given various reductions in thickness by cold rolling showed parallel but rather erratic changes in magnetic hardness, measured by inverse maximum permeability, and X-ray strains, measured by range in angles of incidence on single crystals. [See preceding Abstract.] AUTHORS.

356. Influence of Pressure on the Curie Point of Ni-Cu Alloy. A. Michels, A. Jaspers, J. de Boer and J. Strijland. *Physica,* 4. *pp.* 1007–1016, *Nov.,* 1937. *In English.*—The effect of pressure on the resistance phenomena near the Curie-point of a Cu-Ni alloy (70 : 30) has been determined. The Curie temperature increases with increasing pressure by 6×10^{-5}°/atm. The result is discussed in connection with recent theories on ferromagnetism. AUTHORS.

***357. Improved Continuously Variable Self- and Mutual-Inductor. H. B. Brooks and A. B. Lewis.** *Bureau of Standards, J. of Research,* 19. *pp.* 493–516, *Nov.,* 1937.—The features to be desired in a continuously variable self- and mutual-inductor and the extent to which a particular existing type of inductor meets these requirements are stated. The investigation here reported had as object the improvement of the design of this inductor. Two new general theorems concerning a pair of mutually inductive coils are derived. They apply to coils of any form, capable of change of relative position. If the self-inductance of the two coils in series has an upper value L_u for a certain relative position and a lower value L_l for a second relative position, and if either coil may be rewound with any desired number of turns without change of space factor, the first theorem states that the ratio L_u/L_l will have its maximum value when the self-inductances of the two coils are equal. The second theorem relates to a quantity which is arbitrarily called the "characteristic time-constant" of the pair of coils for the given relative positions and is equal to $(L_u - L_l)/(R_1 + R_2)$, where R_1 and R_2 are the resistances of the coils. This time-constant will have its maximum value when $R_1 = R_2$. When $L_1 = L_2$ and $R_1 = R_2$ the requirements for maximum L_u/L_l and for maximum characteristic time-constant are satisfied. An added advantage of this set of conditions is that when the two coils are connected in parallel the value of the self-inductance, for any given relative position of the coils, will be exactly one-fourth of the corresponding value for the series connection. The procedure which was used in applying the new theorems to the design of an improved inductor and the performance of the finished instrument are given in detail. AUTHORS.

***358. Axial Magnetic Suspensions. F. T. Holmes.** *Rev. Sci. Instruments,* 8. *pp.* 444–447, *Nov.,* 1937.—A vertical ferromagnetic needle can be supported in macroscopic equilibrium by magnetic forces alone. One method using a variable magnetic field is described and shown to have considerable latitude in details of application. A 6 gm. rotor having a moment of inertia of about 0·8 gm.cm^2. was suspended in this manner. It was spun at about 1200 r.p.s., its behaviour indicating that with suitable driving arrangements much higher speeds should be attainable. At 600 r.p.s. with driving torque zero it exhibited a deceleration of about 2×10^{-3} r.p.s.^{2} A suspended element weighing about $\frac{1}{2}$ gm. showed torsion constants, depending on adjustments, down to 7×10^{-6} dyne cm./rad. AUTHOR.

See also Abstracts 244, 307.

MEDICAL RADIOLOGY AND ELECTROLOGY.

359. Changes in Human Brain Potentials during the Onset of Sleep. H. Davis, P. A. Davis, A. L. Loomis, E. N. Harvey and G. Hobart. *Science,* 86. *pp.* 448–450, *Nov.* 12, 1937.—The electrical potential of the brain, recorded in wave form, shows 5 variations in type as a person goes to sleep. These changes are discussed and illustrated but the actual apparatus and method are not described. B. J. L.

***360. Nomogram and Exposure Calculator for Radiography. A. B. MacLean.** *Brit. J. of Radiology*, 10. *pp.* 753–758, *Oct.*, 1937.—The nomogram relates the three variables, exposure in milliampere seconds, kilovoltage and the thickness of the object radiographed, and is claimed to be valid for 4-valve, 1-valve and unrectified apparatus. The corrections appropriate for various operating distances and for the use of Potter-Bucky diaphragms are given. The exposure calculator is essentially another form of the nomogram, in which the three scales are marked on the circumferences of two concentric circles, the inner and smaller one of which can be turned with respect to the other. By this instrument exposures can be read off at once. G. E. B.

361. Radiation Dosimetry. L. H. Gray. *Brit. J. of Radiology*, 10. *pp.* 721–742, *Oct.*, 1937.—A continuation of a previous paper [see Abstract 4727 (1937)] and dealing mainly with the ionisation produced in air at a given distance from a Ra source. Among the various factors discussed are the nature and thickness of the wall material of the chamber, the absorption of γ-rays in the chamber walls, the validity of the inverse square law in the circumstances, and the influence of radiation scattered by the walls of the room, etc. It is concluded that the ionisation equivalent of the γ-ray energy absorbed per unit volume of air is $8 \cdot 4$ e.s.u./cm.^3/hr. and that this is the dosage rate per hour at 1 cm. from 1 mg. Ra filtered by $0 \cdot 5$ mm. Pt. The causes of certain discrepancies are considered. G. E. B.

***362. Quantum-Counter Amplifiers for γ-Ray Detection, and Applications to Studies in Radium Poisoning. Robley D. Evans.** *Am. Phil. Soc., Proc.* 78. 1. *pp.* 11–21, 1937.—A portable, rugged amplifier, with a direct reading counting-rate-meter, has been developed for the study of feeble γ-rays. The instrument has been simplified so as to permit successful operation for those not specifically trained in experimental physics. Quantities of Ra of the order of 5×10^{-8} gm. or more may be determined in a few minutes. Calibrations have been made for determining the amount of Ra contained in living victims of radium poisoning. AUTHOR.

363. Radiating Surfaces. Part II. J. van Roojen. *Brit. J. of Radiology*, 10. *pp.* 781–816, *Nov.*, 1937.—The author continues the mathematical investigation of the correct points of radiation in order to radiate effectively a given region of tissues. The process is extended to γ-rays as well as X-rays. No simple summary of results is possible. [For Part I see Abstract 5118 (1937).] E. H. W. B.

See also Abstracts 150, 369 and

147B. Portable H.V. X-Ray Therapy Unit. I. I. Kaplan and S. Rubenfeld.

OSCILLATIONS AND WAVES.

364. Report on the First International Congress on Short Waves in Physics, Biology and Medicine, Vienna, 1937. O. Stierstadt. *Zeits. f. techn. Physik*, 18. 9. *pp.* 241–251, 1937.—Short accounts of the deliberations of the Congress grouped under the following main headings: (1) Investigations into the ionosphere, (2) the production of short waves, (3) applications of short waves in physics and technology, (4) dosimetry and measurement. G. E. B.

***365. Two-Pulse Oscillator. I. A. Getting.** *Rev. Sci. Instruments*, 8. *pp.* 412–413, *Nov.*, 1937.—A circuit is described which produces pairs of pulses at any frequency up to about 6000 per sec. The members of the pair may be arbitrarily close and of arbitrary amplitude. The circuit is for testing resolving powers of pulse-recording circuits. AUTHOR.

✱366. Production and Absorption of Electromagnetic Waves from 3 cm. to 0·6 cm. in Length. N. H. Williams. *J. of Applied Physics*, 8. *pp.* 655–659, *Oct.*, 1937.—A prediction that NH_3 should absorb waves 1·5 cm. long led the author and C. E. Cleeton to devise apparatus for the generation, measurement and detection of waves of this order. Magnetrons were used and the following table gives the essential features of a series of specially small types constructed for this work.

R_a	L	V	H	λ
0·045	0·99	830	6,600	1·87
0·035	0·75	1350	9,900	1·22
0·019	0·38	1200	24,000	0·64

R_a is the anode radius in cm., L is the distance from the filament to the end of the frame, V is anode potential in volts, H is magnetic field strength in oersteds, and λ is wave-length in cm. Iron pyrite-phosphorbronze was found to be the best crystal detector. The wave-lengths were measured by an echelette grating consisting of 18 strips of Al 7·5 by 70 cm. The spectrum was pure and orders up to the seventh could be measured. The error was less than 1%. F. S. B.

✱367. Current and Potential Measurements with Ultra-Short Waves. J. Malsch. *Ann. d. Physik*, 30. 6. *pp.* 534–540, *Nov.*, 1937.—In the region of 1 m. and 0·1 m. waves, measurements are very difficult, and except in special cases where Lecher wires can be used the only method previously available was the use of the hot-wire air thermometer described by E. Keutner [see Abstract 4846 (1936).] In the method now described the shimmer round the hot wire, which is a Pt.-Ir. wire of 0·021 mm. dia. is utilised to effect changes in the quantity of light passing through an optical system on to a photoelectric cell. Constructional details of the hot-wire element are given, and also a curve showing the sensitivity of the apparatus both as regards mA and mW against galvanometer deflections. In both cases the relation is linear. G. G.

368. Electric Spectrum of Liquid Water for 5-20 cm. Wave-lengths. H. W. Knerr. *Phys. Rev.* 52. *pp.* 1054–1067, *Nov.* 15, 1937.—A magnetron generator was used in the production of continuous electromagnetic radiation of wave lengths 5–20 cm., and the refractive index and absorption index of water were determined for 19 wave-lengths in this range by the conventional free wave method and by a wire wave method, both methods being discussed and analysed in detail. A comparison of the two methods at a wave-length of 10·20 cm. showed agreement to within 1%. The absorption index increased steadily from 0·048 at 20·44 cm. to 0·153 at 4·80 cm. The average refractive index was 8·80 ± 0·6%. There was no clear evidence of dispersion but an expected slight variation of refractive index lay within the limits of experimental error. N. M. B.

369. Diffractive Propagation of Radio Waves. Part III. B. Wwedensky. *Techn. Phys., U.S.S.R.* 4. 8. *pp.* 579–591, 1937. *In English.*—The formulæ given previously [see Abstract 935 (1937)] for diffractive propagation of radio waves radiated by a vertical dipole on a spherical earth, the influence of conductivity currents being predominating ($2\sigma\lambda \gg \epsilon c$) is extended to the case of ground for which the displacement current is comparable with or even exceeds the conductivity current. The formulæ obtained are suitable for separations close to or greater than geometrical visibility. Comparision with experimental results for the propagation of ultra-short waves found by Jones, and Trevor and Carter, show in a number of cases sufficiently satisfactory agreement relative to the absolute values of field intensity, no arbitrary constants being introduced into the formula to obtain this. AUTHOR.

370. Ionosphere during Solar Eclipse, June 8th, 1937. I. Ranzi. *N. Cimento*, 14. *pp.* 262–264, *June*, 1937.—During the eclipse which was visible in the Pacific, the author observed, in Bologna, an appreciable decrease in electron-density in the F_2-region. This is explained on the grounds of a theory of ionisation in this region by solar electrons. [See Abstract 4731 (1937).]

371. Astrophysical Problems of the Ionosphere. *J. of Applied Physics*, 8. *pp.* 709–756, *Nov.*, 1937.—Various authors contribute to a symposium on the subject :—

N. E. Bradbury (*pp.* 709–717) describes the replacement of the older qualitative observations by quantitative laboratory methods. The results of fundamental experiments on photoionisation, recombination of positive ions and electrons, and formation and destruction of negative ions, are discussed. The author concludes that when coupled with proper diffusion equations, the experimental relations are now ready for application to the equilibrium state of the ionosphere during the day and to the variation at night when the ionising source is removed.

A. G. McNish (*pp.* 718–731) gives an account of various theories propounded to explain the diurnal variations of terrestrial magnetism. Recent radio sounding of the ionosphere during chromospheric eruptions enables these theories to be tested. The radio observations point to the creation of an absorbing layer at the base of or below the E-region. The magnetic effects consist of large changes in the magnetic force. The hypothetical current system needed to produce such changes is an increase in the normal diurnal variation current, probably arising from the same improved conductivity which causes the radio fading. It is therefore supposed that the normal variations themselves are caused by tidal currents below the E-layer (Stewart's theory). The effects during magnetic storms and total eclipses are also discussed.

J. H. Dellinger (*pp.* 732–751) summarises the data which have accumulated on sudden disturbances in radio transmission, in terrestrial magnetism, and in earth currents, and interprets them in terms of ionisation changes caused in the ionosphere by solar eruptions. The effects reach a maximum where the sun's radiation is perpendicular, and disappear on the dark side of the earth. The radiation concerned is of such frequency as to cause intense ionisation just below the E-layer. It is more likely to be extreme u.v. line emission by H than black-body radiation.

R. S. Richardson (*pp.* 752–756) describes the bright chromospheric eruptions which are associated with these terrestrial effects. They have been observed in the D lines of Na, the D_3 line of He, the *b* lines of Mg, the H and K lines of Ca^+, and many of the Balmer lines of H. Their relation to sunspots, their life-history, their frequency, and their similarity as observed in $H\alpha$ and in K_2 are described and discussed. It appears that 2, 3, or even 4 eruptions may occur simultaneously at different points on the disc. A deep-seated disturbance in the sun's interior is therefore indicated. Spectroheliograms in continuous light suggest that the phenomenon is primarily one of line emission in the chromosphere, not of black-body radiation from the photosphere. A. Hu.

372. Chromospheric Eruptions and Ionospheric Disturbances. M. Waldmeier. *Zeits. f. Astrophysik,* 14. 4. *pp.* 229–241, 1937.—It is shown that the frequency of ionospheric disturbances (measured by short-wave radio fadings) runs parallel to that of solar eruptions observed spectrohelioscopically in Hα light. The correspondence as a whole is only statistical, but the phenomena occur nearly simultaneously in a great number of individual cases—at least 10 times as many as would be expected from chance coincidences. Not all eruptions produce perceptible fading, though the more intense are usually accompanied by other geophysical effects, but at least 80% of all fade-outs are associated with eruptions. No certain correlation of frequency of fading with the solar rotation period is found. From the distribution of the disturbances over the earth and of the eruptions over the sun it is clear that the cause of the fading is short-wave electromagnetic radiation. Spectroscopic observations make it probable that eruptions emit such extreme u.v. radiation. A. Hu.

373. New Results of Ionosphere Investigations and their Importance in Geophysics. R. Penndorf. *Naturwiss.* 25. *pp.* 774–779, *Nov.* 26, 1937.—The results obtained in various investigations of the properties of the ionosphere are discussed with special reference to the correlation between the observed variations of layer height, ion content of layers, etc., and variations of geophysical quantities such as atmospheric electricity, the aurora and the earth's magnetic field. A. W.

374. Variation of the Ionisation of the Highest Layers of the Atmosphere during Northern Light and Terrestrial Magnetic Disturbances. L. Harang. *Geofysiske Publ.* 11. 17. [54 *pp.*], 1937. *In German.*—Following a discussion of the theory of the propagation of radio waves in an ionised layer, an account is given of experimental work carried out at Tromsö during the period April, 1935, to March, 1936, on the behaviour of echoes from the upper layers of the atmosphere. Data are tabulated regarding (*a*) the annual variations at mid-day of the critical frequencies, (*b*) the effect of magnetic disturbances on the mid-day observations of the critical frequencies, (*c*) variations of the reflecting power of the ionised layers in periods of terrestrial magnetic activity, (*d*) daily observations of the critical frequencies for determining the daily variations of ionisation. The following points are also dealt with: (1) variation of the recombination coefficient during the year; (2) general behaviour of the daily curves; (3) vertical movement of air masses near the level of the E-layer, and (4) ionisation of the highest layers of the atmosphere by solar radiation and the problem of the two layers. A. W.

375. Studies of the E-Region of the Ionosphere. J. E. Best, F. T. Farmer and J. A. Ratcliffe. *Roy. Soc., Proc.* 164*A*. *pp.* 96–116, *Jan.* 7, 1938.—Investigations of region E of the ionosphere have been made using a Breit and Tuve pulse sender of variable frequency. By using visual observation at the receiver and a remote control of the sender it was possible to follow the variations of frequencies characteristic of the ionosphere even when ionospheric conditions were changing rapidly. In the winter it was possible to observe true critical frequencies for region E and a curve is given which represents the mean of observations taken on "ionospherically quiet" occasions near 16 Dec., 1936. From this curve it is deduced that the night-time value of the recombination coefficient is 4×10^{-9}, whereas the day-time value is of the order of three times greater. In the summer it was more natural to observe certain "threshold frequencies" at which the amplitudes of the region E and region F echoes underwent marked changes. Reasons are given for supposing that, on ionospherically quiet days, one of these threshold frequencies approximates closely to the true critical frequency of region E. The diurnal variation of this threshold frequency was studied for "quiet" days. Observations of the threshold frequencies on days which were ionospherically disturbed can be explained on the supposition that region E is then not uniformly stratified in horizontal planes but contains "clouds" with electron density greater than that of their surroundings. The simultaneous reflection of waves from regions E and F over a considerable range of frequencies is explicable on this hypothesis. The conditions here considered are supposed to be intermediate between those which we call "quiet" and those which are characterised by the occurrence of "abnormal," "intense," or "sporadic" region E ionisation. An investigation of region E during thunderstorms and thundery weather in 1936 showed no correlation between the storms and the behaviour of the region. An examination of some data obtained between 1932 and 1934 shows no correlation such as Martyn and Pulley found in Australia between the occurrence of nocturnal region E ionisation and barometric pressure. AUTHORS.

See also Abstracts 291, 313, 345 and

78B. Frequency Standards. R. Mitenda, K. Tani and Y. Kusunose.
239B. Ionisation of the F_2-Region. W. M. Goodall.
240B. Ionosphere Measurements. K. Maeda and T. Tukada.
242B. Theory of Plane Electromagnetic Waves. S. A. Schelkunoff.
243B. Electromagnetic Wave Fields near Earth's Surface. C. R. Mingins.

PHOTOELECTRICITY.

376. Normal Energy Distribution of Photoelectrons from Sodium. C. F. J. Overhage. *Phys. Rev.* 52. *pp.* 1039–1047, *Nov.* 15, 1937.—The theory of the normal energy distribution of photoelectrons has been reformulated by including the effect of contact potential; if photoelectric currents are plotted against applied retarding potentials, the apparent stopping potential at 0° K. is shown to be independent of the kathode work function. Apparatus has been constructed for the precise determination of the normal energy distributions of photoelectrons from Na. Photoelectric currents emitted by monochromatic light were measured after passage through a retarding field. The results of such measurements were found to vary with changes of the anode potential barrier. Energy distribution curves taken at different frequencies exhibit satisfactory mutual consistency; when plotted logarithmically they are of identical shape. This shape does not agree with the theoretically predicted normal energy distribution. An explanation for this discrepancy is given in terms of the structure of the anode potential barrier. A method for the determination of h/e is suggested, which is based on the consistency in shape of the empirically determined curves. [See following Abstract.] AUTHOR.

377. Surface Photoelectric Effect. W. V. Houston. *Phys. Rev.* 52. *pp.* 1047–1053, *Nov.* 15, 1937.—The probability of ejection of an electron in the surface photo-effect is expressed in terms of a function of the potential barrier, the energy of the electron after ejection, and the frequency. This function is dominated, for low energies of ejection, by the transmission coefficient of the surface. It is then assumed that the function can be expanded in a power series in terms of the energy of the electron after ejection. In calculating the total emitted current it is shown that the power series development leads to a series of distinctive functions expressing the current in terms of the frequency and the stopping potential. Each of these functions has its own temperature dependence, so that from a complete knowledge of the energy distribution and the temperature dependence of the emitted current it would be possible to draw conclusions as to the nature of the potential barriers. By comparing the theoretical expressions with the observed curves of Overhage, and of Mann and DuBridge, it is possible to conclude that the transmission coefficient of Overhage's anode and of the sodium kathode used by Mann and DuBridge vanished linearly with the diminishing energy of the ejected electrons. [See preceding Abstract.] AUTHOR.

378. Selective Photoelectric Effect Using Mixed-Sheet Oxide Kathodes. R. Fleischer and H. Pietzsch. *Zeits. f. Physik*, 107. 5–6. *pp*. 322–331, 1937.—Continuing previous work, examination is made of the effect of the application of small external potentials on the maximum of the selective photoelectric yield from mixed sheets contained in either vacuum- or gas-filled cells. The selective maximum is observed to change to longer wave-lengths as the external potential is increased to 2 V. Explanation of this and of attendant phenomena is given in terms of the additional energy imparted by the external field to electrons liberated some distance below the surface of the oxide sheets. F. C. C.

379. Action of Kathode Rays on Selenium Cells. A. Becker and E. Kruppke. *Zeits. f. Physik*, 107. 7–8. *pp*. 474–484, 1937.—Kathode rays are used instead of light to excite photoelectric cells. The variation of photoelectric current with bombarding current is measured for two different energies of the bombarding electrons, 5 and 20 ekV. The variation is non-linear, the photoelectric current increasing more slowly as the bombarding current increases. The variation is also measured for energies up to 40 ekV, the curves showing first a rapid increase followed by a broad maximum and a slow decline. A correction is applied for the loss of energy of the bombarding electrons in passing through an electrode. The authors conclude that only photoelectrons from a restricted thickness of Se reach the electrode, the others being lost by absorption. It is suggested that photoelectric cells may be developed to measure kathode-ray currents. K. M. C.

380. Influence of Temperature on Primary Photoelectric Current in Alkali Halide Crystals. G. Glaser. *Göttingen Nachrichten, Fachgruppe II*. 3. 2. *pp*. 31–44, 1937.—This is an extension of similar work previously published [see Abstract 3905 (1936)]. Measurements were made on KCl crystals over an extended range of temperature with colour-centres produced in four different ways. It was found that the electron free paths and the colour-centre concentrations were inversely proportional. Similar measurements were performed on RbCl, RbBr and KBr. KI was examined but the results were prejudiced by the partial conglomeration of the colour-centres to form a colloid. The complications arising from colloid formation were studied in KCl. D. H. F.

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381. Secondary Photoelectric Current. R. Hilsch and R. W. Pohl. *Göttingen Nachrichten, Fachgruppe II.* 3. 3. *pp.* 45–53, 1937.—The secondary photoelectric current in an illuminated crystal is treated mathematically. A general equation is derived giving the photoelectric current, covering cases where there is a primary component only, or both primary and secondary components, for crystals with dark currents of any kind and magnitude. D. H. F.

See also Abstracts 349, 385.

THERMIONICS.

382. Shot Effect of Secondary Electrons from Nickel and Beryllium. B. Kurrelmeyer and L. J. Hayner. *Phys. Rev.* 52. *pp.* 952–958, *Nov.* 1, 1937.—The secondary emission ratios and shot effects from Ni and Be were measured over a range of primary energies up to 1600 V. The results are consistent with the following conclusions. At high primary energies the true secondary electrons, as distinguished from the reflected primaries, are emitted in groups whose distribution in size about the average is closely Bernoullian. There are many primaries which are buried in the body of the metal and produce no secondaries; their number has been determined. Disregarding reflected and buried primaries, the secondary emission ratio is nearly proportional to the square root of the primary energy. At low primary energies the effects of reflection, both internal and external, can be followed in detail. [See also Abstract 914 (1936).] AUTHORS.

383. Influence of Space Charge on a Current in a Vacuum. S. Bellustin. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 16. 6. *pp.* 299–304, 1937. *In English.*—Langmuir's equations for the space charge admit a one-parameter set of transformations and can therefore be reduced to equations of the first order. It is therefore possible to give a complete discussion of the solutions, for arbitrary boundary conditions for field and electron velocity. R. P.

384. Temperature Variation of the Work Function of Clean and of Thoriated Tungsten. A. L. Reimann. *Roy. Soc., Proc.* 163*A*. *pp.* 499–510, *Dec.* 22, 1937.—Measurements were made of the contact p.d. between a constant source of electrons and a neighbouring W filament collecting space-charge-limited electron current, whose condition was varied. This filament was either clean or covered with a layer of Th atoms, and, in addition, it was held at various temperatures. In this way direct information was obtained concerning the rates at which the work functions of clean and fully activated thoriated tungsten (W-Th) vary with temperature. Within the limits of experimental uncertainty there is no difference between the temperature coefficients of the two work functions. The temperature coefficient found is about that which would be required to account for the observed value of the thermionic constant A of clean W on the assumption of practically perfect transmission. It must be concluded that the factor (of the order of 10–20) by which the A of W-Th is less than that of clean W is due to internal reflection of electrons at the W-Th surface. AUTHOR.

385. Influence of External Field on the Electron Emission Constants of Ba-Coated Platinum Surfaces. R. Suhrmann and J. L. v. Eichborn. *Zeits. f. Physik,* 107. 7–8. *pp.* 523–548, 1937.—Measurements were made of the total photoelectric emission from Pt wires, coated with Ba, as dependent on the temperature of the radiating source, for different anode potentials ($V_A = 0{\cdot}25$ to 967V). From the results thus obtained the dependence of the emission potential ψ and the quantity constant M on the external field ($E_a = 11$ to 42,000 V/cm.) was calculated. The ψ and $\sqrt{E_a}$ curves show at first a marked decrease and then a slight decrease of ψ with increasing external field. The log M and $\sqrt{E_a}$ curves show a similar behaviour of M with increasing external field. With high field strength the curves obtained for thickly coated surfaces show a point of inflection. The results obtained are discussed and possible explanations are suggested. A. W.

386. Evidence for Halogen Films on Tungsten in the Surface Ionisation of Potassium Halides. J. O. Hendricks, T. E. Phipps and M. J. Copley. *J. Chem. Phys.* 5. *pp.* 868–872, *Nov.*, 1937.—Molecular rays of the potassium halides were directed in high vacuum against W and W-O_2 surfaces, and the positive ion current to a collector cylinder was measured as a function of the surface temperature. Degrees of ionisation on O_2-free surfaces were calculated upon the assumption that each halide molecule produced one positive ion on striking a W-O_2 surface. The high temperature results on O_2-free filaments (1800°–2380° K) were interpreted as indicating surface dissociation of the potassium halide molecule, followed by partial ionisation of the K atom and by the escape of the halogen as an atom. In the approximate temperature range 1800–1600° K a progressive change in the surface, with decreasing temperature, toward a higher work function was observed. This change led to surfaces of constant high work function, which were interpreted as due to the formation of halogen layers on the W. AUTHORS.

387. Thermionic Emission of Positive Ions from Molybdenum. H. Grover. *Phys. Rev.* 52. *pp.* 982–986, *Nov.* 1, 1937.—The assumption that ionisation of an atomic system leaving a metal surface is due to electron exchange with the surface leads to an equation for the temperature variation of the current density of the thermionic positive ions. For certain cases, this equation reduces to that developed by thermodynamical considerations. Mass-spectrograph studies of Mo and of W show that ions of alkali impurities may persist after ageing the specimens as long as 1100 hrs. Ion currents due to such impurities cause an apparent lowering of the measured work function of characteristic ions. An experimental method for eliminating the effect of these impurities is described. The ion work function thus obtained for Mo is 8·9 eV. This value closes the familiar energy cycle. AUTHOR.

THERMOELECTRICITY.

See Abstract 308.